BITSAT 2024 Question Paper with Solution

Birla Institute of Technology and Science Admission Test (BITSAT)

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BITS

Physics

√tAitBess A = 1.0 m ± 0.2 m, B = 2.0 m ± 0.2 m. We should as a

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A. 11 1.441m

±±

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Solution:

Given, $A = 1.0\ \mathrm{m} \pm 0.2\ \mathrm{m}, B = 2.0\ \mathrm{m} \pm 0.2\ \mathrm{m}$

Let $Y = \sqrt{AB} = \sqrt{(1.0)(20)} = 1.414\ \mathrm{m}$

Rounding off to two significant digits

$$Y = 1.4\ \mathrm{m}$$

$$\frac{\Delta Y}{Y} = \frac{1}{2}\left[\frac{\Delta A}{A} + \frac{\Delta B}{B}\right]$$

$$= \frac{1}{2}\left[\frac{0.2}{1.0} + \frac{0.2}{2.0}\right]$$

$$= \frac{0.6}{2 \times 20}$$

$$\Rightarrow \quad \Delta Y = \frac{0.6Y}{2 \times 20} = \frac{0.6 \times 1.4}{2 \times 20} = 0.212$$

Rounding off to one significant digit,

$\Delta Y = 0.2\ \mathrm{m}$ nsional formula of latent h at is:

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Heat, $\mathbf{Q} = \mathbf{mL}$ where, $\mathbf{L}$ = latent heat

$$\therefore \mathbf{L} = \frac{\mathbf{Q}}{\mathbf{m}} = \frac{\mathbf{ML^2\,T^{-2}}}{\mathbf{M}} = \mathbf{M^0\,L^2\,T^{-2}}$$

L 2dimensio]ns of coefficient of self inductance are

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Energy stored in an inductor, $\mathbf{U} = \frac{1}{2}\mathbf{LI^2}$

$$\Rightarrow \quad \mathbf{L} = \frac{\mathbf{2U}}{\mathbf{I^2}}$$

$$[\mathbf{L}] = \frac{[\mathbf{ML^2\,T^{-2}}]}{[\mathbf{A}]^2} = [\mathbf{ML^2\,T^{-2}\,A^{-2}}]$$

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Displacement, $x = t^3 - 6t^2 + 20t + 15$

$\therefore$ Velocity, $v = \frac{dx}{dt} = 3t^2 - 12t + 20$

$\therefore$ Acceleration, $a = \frac{dv}{dt} = 6t - 12$

When $a = 0$

$\Rightarrow 6t - 12 = 0 \Rightarrow t = 2\ s$

At $t = 2\ s, v = 3(2)^2 - 12(2) + 20 = 8\ m/s$

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$t_n = u + \frac{a}{2}(2n - 1)$

put $u = 0, a = \frac{4}{3}\ ms^{-2}, n = 3$

$\therefore \quad d = 0 + \frac{4}{3 \times 2}(2 \times 3 - 1) = \frac{4}{6} \times 5 = \frac{10}{3} m$

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$$t = \frac{u \sin\theta}{g}$$

$$\Rightarrow \quad u = \frac{gt}{\sin\theta} \ldots (i)$$

Since,

$$R = u\cos\theta \times (2t)$$

$$\Rightarrow \quad \cos\theta = \frac{R}{2ut}$$

$$\Rightarrow \quad \cos\theta = \frac{R}{2 \cdot \frac{gt}{\sin\theta} \cdot t}$$

$$= \frac{R\sin\theta}{2gt^2} (Using (i))$$

$$\Rightarrow \quad \cot\theta = \frac{R}{2gt^2} = \frac{R}{[illegible]} = \frac{R}{[illegible]}$$

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A. $\frac{\alpha^2}{2\beta}$

B. $\frac{\alpha^2-\beta^2}{2\alpha}$

C. $\frac{\alpha^2-\beta^2}{2\beta}$

$\frac{(\alpha-\beta)\alpha}{2}$

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$\omega = \alpha - \beta t$. Comparing with $\omega = \omega_0 - \alpha t$

Initial angular velocity $= \alpha$

Angular'retardation $= \beta$

$\therefore$ Angle rotated before it stops is $\frac{\alpha^2}{2\beta}$. [using

$\omega^2 = \omega_0^2 + 2\beta\theta]$ jemcete vde laotc aitny a antg alen oafn 1g5le owfi4th 5 h woritizho

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$R = \frac{v^2 \sin 2\theta}{g} (\because R \propto \sin(2\theta))$

$\frac{R_1}{R_2} = \frac{\sin(2\theta_1)}{\sin(2\theta_2)} = \frac{\sin(2\times15)}{\sin(2\times45)} = \frac{\sin 30^\circ}{\sin 90^\circ}$

$\Rightarrow \frac{50}{R_2} = \frac{1}{2} \Rightarrow \mathrm{R_2 = 100\ m}$

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$\frac{\sqrt{3}}{16} \frac{\mathrm{mu^3}}{\mathrm{g}}$

$\frac{\sqrt{3}}{2} \frac{\mathrm{mu^2}}{\mathrm{g}}$

$\frac{mu^3}{\sqrt{2}g}$
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Angular momentum, $L = mvH = mu\cos 30H$

$= mu\cos 30^\circ \times \frac{u^2\sin^2\theta}{2g}\left[\because H = \frac{u^2\sin^2\theta}{2g}\right]$

$= \frac{mu^3}{2g} \times \frac{\sqrt{3}}{2} \times \left(\frac{1}{2}\right)^2 = \frac{\sqrt{3}mu^3}{16g}$

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Time of flight $= \frac{2u\sin\theta}{g}$

$= \frac{2\times 9.8\times \sin 30^\circ}{9.8} = 2 \times \frac{1}{2} = 1\text{sec}$

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1 $\frac{\sqrt{2}-1}{\sqrt{2}+1}$

A.

$\frac{1+\sqrt{5}}{\sqrt{5}-1}$

B.

$\frac{1+\sqrt{5}}{\sqrt{2}-1}$

C. $\frac{\sqrt{3}+1}{\sqrt{2}-1}$

A.

D lieo rna:t ion is given as:

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$a=\left(\frac{m_2-m_1}{m_1+m_2}\right)g$

$\Rightarrow \frac{g}{\sqrt{2}}=\left(\frac{m_2-m_1}{m_1+m_2}\right)g$

$\Rightarrow \sqrt{2}\left(m_2-m_1\right)=m_1+m_2$

$\Rightarrow \frac{m_1}{m_2}=\left(\frac{\sqrt{2}-1}{\sqrt{2}+1}\right)$

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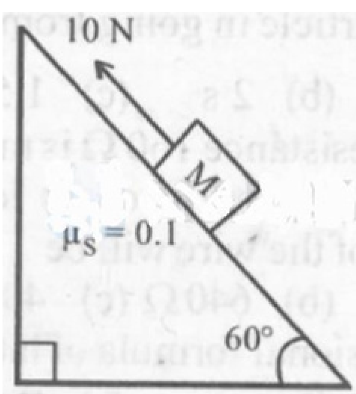

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Mass of block, $m = 1\ \mathrm{kg}$

Force of parallel inclined surface, $\mathrm{F} = 10\ \mathrm{N}$

Work done against frictional force

$$= \mu_2\ \mathrm{N} \times 10 = \mu \mathrm{Mg} \cos 60 \times 10 = 0.1 \times 5 \times 10 = 5\ \mathrm{J}$$

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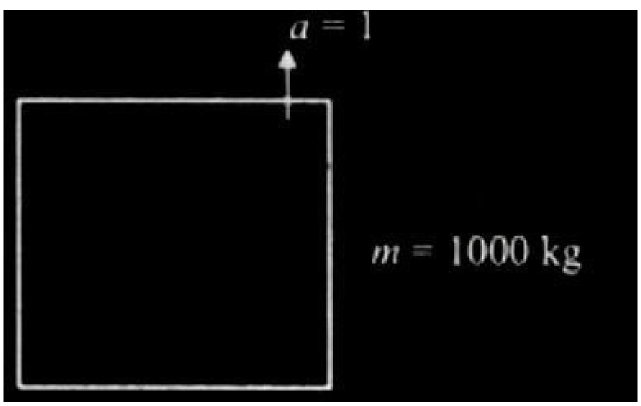
Solution:



Total mass $= (60 + 940)\text{kg} = 1000\ \text{kg}$

Let T be the tension in the supporting cable, then

$T - 1000g = 1000 \times 1$

$\Rightarrow \mathbf{T} = 1000 \times 11 = 11000\ \mathbf{N}$

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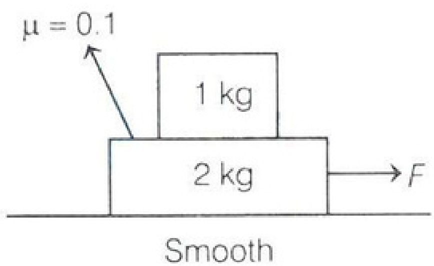

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Common accelerat ion without relative motion between two blocks may be,

$a_{\max} = \mu g = 1\ \mathrm{m/s^2}$

$a = \frac{0.5}{3}\ \mathrm{m/s^2}$

Since, $a < a_{\max}$

There will be no relative motion and blocks will move with acceleration $\frac{0.5}{3}\ \mathrm{m/s^2}$.

Force of friction by lower block on upper block,

$$f = ma = (1)\left(\frac{0.5}{3}\right) = \frac{1}{6}\text{ N(towards right)}$$

$$\therefore \quad W = f \times s$$

$$= \frac{1}{6} \times 3 = 0.5\text{ J}$$

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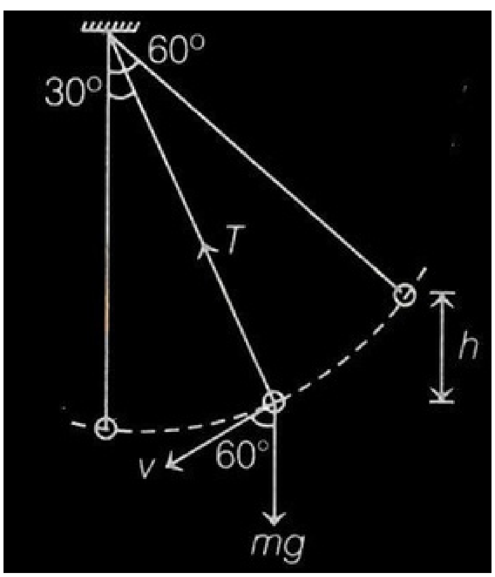

$$\text{Power of } mg = (mg)(v)\cos 60^\circ$$

$$\text{Here,} \quad v = \sqrt{2gh}$$

$$\text{and} \quad h = l(\cos 30^\circ - \cos 60^\circ) = 0.36 \text{ m}$$

$$v = \sqrt{2 \times 10 \times 0.36}$$

$$= 2.68 \text{ m/s}$$

$$\text{Power } = (mg)(v)\cos 60^\circ$$

$$= (1 \times 10)(2.68) \times \frac{1}{2}$$

$$= 1.34 \times 10 = 13.4 \text{ W}$$

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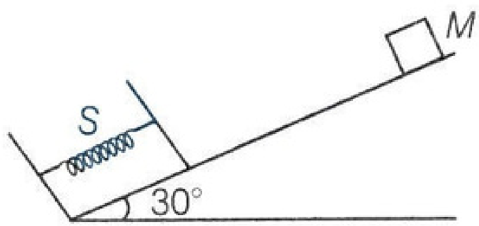

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$$F = kx$$

$$\therefore \quad k = \frac{F}{x} = \frac{100}{1} \text{ N/m} = 100 \text{ N/m}$$

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N

$\frac{1}{2}mv^2 + mgh = \frac{1}{2}kx_{\max}^2$

$$\therefore \quad v = \sqrt{\frac{kx_{\max}^2}{m} - 2gh}$$

$$= \sqrt{\frac{(100)(2)^2}{10} - (2)(10)\left(\frac{2}{2}\right)} = \sqrt{20}\ \mathrm{m/s}$$

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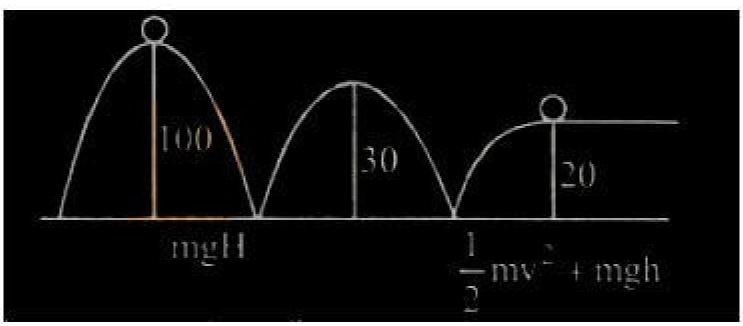

Using conservation of energy,

$\mathrm{m}(10 \times 100) = \mathrm{m}\left(\frac{1}{2}\mathrm{v}^2 + 10 \times 20\right)$

or $\frac{1}{2}v^2 = 800$ or $v = \sqrt{1600} = 40\ \mathrm{m/s}$

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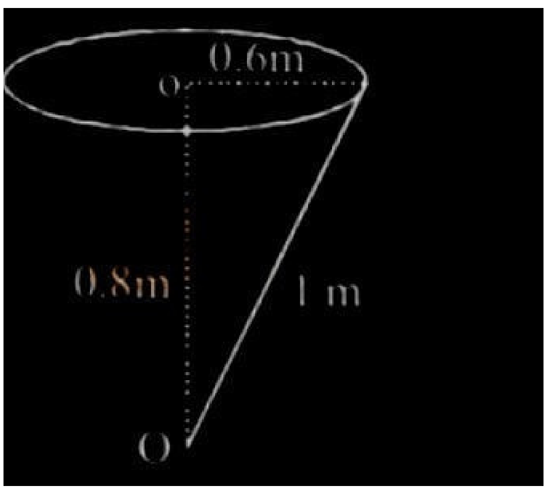
$L_0 = \mathbf{mvr} \sin 90^{\circ}$

$= \mathbf{2} \times \mathbf{0.6} \times \mathbf{12} \times \mathbf{1} \times \mathbf{1}$

[As $V = r\omega$, $\mathbf{Sin}\, 90^{\circ} = \mathbf{1}$]

So, $L_0 = \mathbf{14.4kgm^2/s}$



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Solution:

$$\text{Velocity on hitting the surface } = \sqrt{2 \times 9.8 \times 4.9}$$
$$= 9.8 \text{ m/s}$$

Velocity after first bounce, $v = \frac{3}{4} \times 9.8$

Time taken from first bounce to the second bounce

$$= \frac{2v}{g} = 2 \times \frac{3}{4} \times 9.8 \times \frac{1}{9.8} = 1.5 \text{ s}$$

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$\hat{i} + 2\hat{j} + k$ and $-3\hat{i} - 2\hat{j} + \hat{k}$

20. Twrso bodies of mass 1 kg and 3 kg

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$\hat{i} - 2\hat{j} + \hat{k}$

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$-3\hat{i} - 2\hat{j} + \hat{k}$

AD.

$-2\hat{i} + 2\hat{k}$

$-2\hat{i} - \hat{j} + 2\hat{k}$

Ponolsu. ittiioonn :o f COM of a mass - system is given as,
s A

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$$\vec{r}_{\text{com}} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2} = \frac{1(\hat{i}+2\hat{j}+\hat{k})+3(-3\hat{i}-2\hat{j}+\hat{k}}{1+3}$$

$$= -2\hat{i} - \hat{j} + \hat{k}$$

$$|\vec{r}_{cm}| = |-2\hat{i} - \hat{j} + \hat{k}| = \sqrt{(2)^2 + (1)^2 + (1)^2} = \sqrt{6}$$

Only option (1) magnitude is

$$\sqrt{1^2 + (-2)^2 + 1^2} = \sqrt{6}$$

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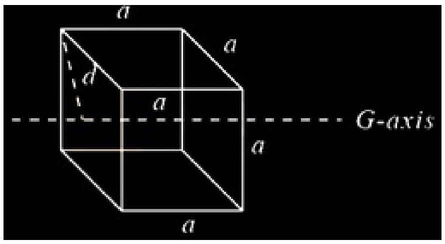
From theorem of perpendicula r axes, we have



$$I = I_C + m\left(\frac{a}{\sqrt{2}}\right)^2$$
$$= \left[\frac{ma^2}{12} + \frac{ma^2}{12}\right] + \frac{ma^2}{2}$$
$$= \frac{2}{3}ma^2$$

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A. $\sqrt{(2gR)}$

B. $\sqrt{(gR)}$

C. $\sqrt{\frac{3}{2}gR}$

AD $\sqrt{(4gR)}$

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Inolsu. B

S cretiaosne: in kinetic energy = Decrease in potential energy

$$\therefore \quad \frac{1}{2}mv^2 = \frac{mgR}{1+\frac{R}{R}} = \frac{mgR}{2} \quad \left(\Delta U = \frac{mgh}{1+\frac{h}{R}}, h = R\right)$$

$$\Rightarrow \quad mv^2 = mgR \Rightarrow v = \sqrt{gR}$$

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iciao llny: 1 year is equal to time period of earth revolution around sun.

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So, $T_i = 1$ year

Now,

$T^2 \propto R^3$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3$

$\Rightarrow T_2 = \left(\frac{R_2}{R_1}\right)^{3/2} T_1 = \left(\frac{3R}{R}\right)^{3/2} \times 1$

$= 3\sqrt{3}$ years particle inside a unifor m spherical shell, the gravitational force on the

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· $\frac{-Gm_1m_2}{r^2}$

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$\frac{Gm_1\, m_2}{r^2}$

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We know that $v_e = \sqrt{2} v_0$, where $\mathbf{v_0}$ is orbital velocity.

K.E. in the orbit, $E = \frac{1}{2} M {v_0}^2$

K.E. to escape $E = \frac{1}{2} M v_e^2 = \frac{1}{2} M \left(2{v_0}^2\right)$

$= \frac{1}{2} M v_0^2 \times 2 = 2E$

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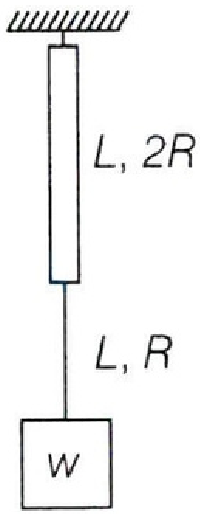

$\frac{3w^2L}{4\pi R^2Y}$

A. $\frac{3w^2L}{8\pi R^2Y}$

B. $\frac{5w^2L}{8\pi R^2Y}$

C.

$\frac{w^2L}{\pi R^2Y}$

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AD.

$$\Delta l_1 = \frac{wL}{(4\pi R^2)Y}, \Delta l_2 = \frac{wL}{\pi R^2Y}$$

$$\therefore U = \frac{1}{2}K_1(\Delta l_1)^2 + \frac{1}{2}K_2(\Delta l_2)^2$$

$$= \frac{1}{2} \times \frac{Y(4\pi R^2)}{L} \times \left[\frac{wL}{4\pi R^2Y}\right]^2 + \frac{1}{2} \times \frac{Y(\pi R^2)}{L}$$

$$\times \left[\frac{wL}{\pi R^2Y}\right]^2 \left(\because K = \frac{YA}{L}\right)$$

$$= \frac{5w^2L}{8\pi R^2Y}$$

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Young's modulus, $\mathbf{Y} = \frac{\text{Stress}}{\text{Strain}}$ ature increases , strain also increases. Hence young's modulus

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$\Delta P_1 = P_1 - P_0 = 0.01 = \frac{4T}{R_1}$ .....(i)

And $\Delta P_2 = P_2 - P_0 = 0.02 = \frac{4T}{R_2}$ .....(ii)

Dividing, equation (ii) by (i),

$\frac{1}{2} = \frac{R_2}{R_1} \Rightarrow R_1 = 2R_2$

Volume $V = \frac{4}{3}\pi R^3 \Rightarrow \frac{V_1}{V_2} = \frac{R_1^3}{R_2^3} = \frac{8R_2^3}{R_2^3} = \frac{8}{1}$

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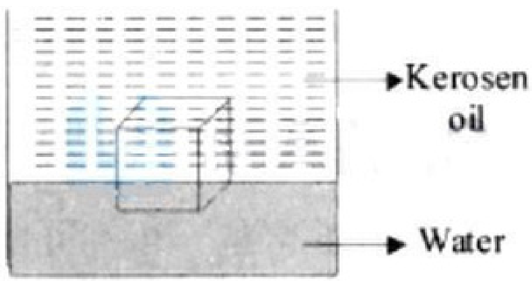

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IVn2

$$v_1 \rho_w g + v_2 \rho_0 g = (v_1 + v_2)\, \rho_c g$$

$$v_1 + \frac{v_2 \rho_0}{\rho_w} = (v_1 + v_2)\, \frac{\rho_c}{\rho_w}$$

$$\Rightarrow v_1 + 0.8 v_2 = 0.9 v_1 + 0.9 v_2 \Rightarrow 0.1 v_1 = 0.1 v_2$$

$$\Rightarrow v_1 : v_2 = 1 : 1$$

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We have $\Delta V = V_0 \gamma \Delta T$

$\Delta V = a^3, (3\alpha) \Delta T$

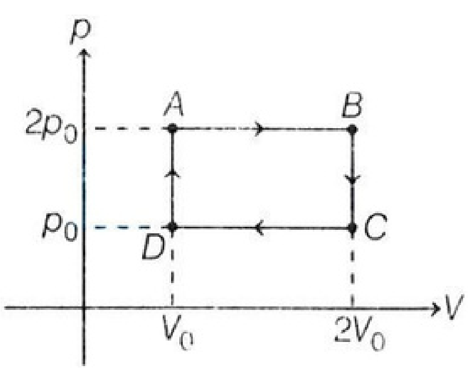
Now, $6a^2 = 24$ $[\because$ Total surface area of cube $= 6a^2]$

$\Rightarrow a^2 = 4 \Rightarrow a = 2$

So, $\Delta V = 2^3 \left(3 \times 5 \times 10^{-4}\right) \times 10 = 1200 \times 10^{-4}\ \mathrm{m}^3$

$= 1200 \times 10^2\ \mathrm{cm}^3 = 1.2 \times 10^5\ \mathrm{cm}^3$

32. In the given cycle ABCDA, the heat re quired for an ideal monoatomic gas will be



V22 p0VV0

B. 1p0V0 p00
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A tB

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$\therefore$ Heat supplied, $Q = nC_V(\Delta T)_{DA} + nC_p(\Delta T)_{AB}$

For an ideal monoatomic gas,

$$C_V = \frac{3}{2}R \text{ and } C_p = \frac{5}{2}R$$

$$\Rightarrow \quad Q = \frac{3}{2}nR\Delta T + \frac{5}{2}nR\Delta T \quad [\because nR\Delta T = p\Delta V]$$

$$= \frac{3}{2}(p_0V_0) + 5\,(p_0V_0)$$

$$= \frac{13}{2}p_0V_0$$

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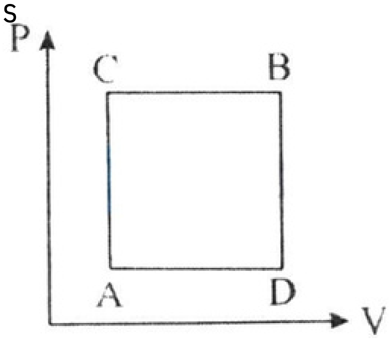

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120J 0 J J
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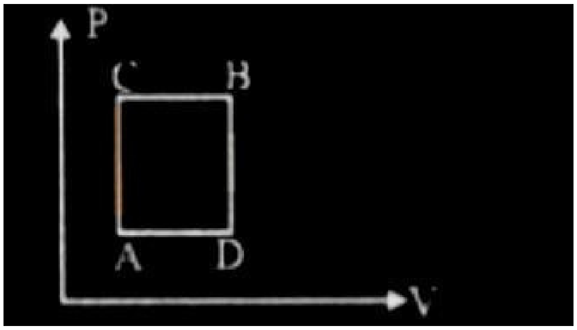
△o tAUlu.io remna: ins same for both paths ACB and ADB
Ans

$$\Delta Q_{ACB} = \Delta W_{ACB} + \Delta U_{ACB}$$



$$\Rightarrow 60\ \mathrm{J} = 30\ \mathrm{J} + \Delta U_{ACB} \Rightarrow U_{ACB} = 30\ \mathrm{J}$$

As change in internal energy depends only on initial and final point

$$\therefore \Delta U_{ADB} = \Delta U_{ACB} = 30\ \mathrm{J}$$

$$\Delta Q_{ADB} = \Delta U_{ADB} + \Delta W_{ADB} = 10\ \mathrm{J} + 30\ \mathrm{J} = 40\ \mathrm{J}$$

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GSos

Rate of heat supplied, $\frac{dQ}{dt} = 1000\ \mathrm{W}$

Rate of work performed, $\frac{dw}{dt} = 200\ \mathrm{W}$

Using first law of thermodynamics

$dQ = dU + dw$

$\Rightarrow \frac{dU}{dt} = \frac{dQ}{dt} - \frac{dw}{dt} \Rightarrow \frac{dU}{dt} = 1000 - 200 = 800$

laet uisr:e of body increases by 40∘C. The increase in

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Since $\frac{F-32}{9} = \frac{C}{5}$

$\Rightarrow \Delta C = \frac{5}{9} \Delta F$

$\Rightarrow 40 = \frac{5}{9} \Delta F \Rightarrow \Delta F = 72^{\circ} F$

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$(v_{rms} = \sqrt{\frac{3RT}{M}}$ and $v_{sound} = \sqrt{\frac{\gamma RT}{M}}$ $\frac{v_{sound}}{v_{rms}} = \sqrt{\frac{\gamma}{3}}$

Degree of freedom is 6 .

$\therefore \quad \gamma = 1 + \frac{2}{f} = 1 + \frac{2}{6} = \frac{4}{3}$

$\therefore \quad v_{sound} = \sqrt{\frac{4/3}{3}} v_{rms} = \frac{2}{3} v_{rms} = \frac{2c}{3}$

v

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n.v 0

RoMlsuStD sio pne:e d,

S

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$\Rightarrow \quad V_{mm} \propto \sqrt{T}$

Here, $T_{initiol} = 200$ K

$T_{fing1} = 800$ K

Initial RMS speed $= v_0$

$\therefore \frac{v_0}{v_{rms}} = \sqrt{\frac{200}{800}} \Rightarrow v_{ms} = 2v_0$

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$\mathrm{n_A} = \frac{1}{2}\ \mathrm{mol}, \mathrm{n_B} = \frac{1}{32}\ \mathrm{mol}$

By ideal gas equation,

$PV = nRT \Rightarrow P \propto n$

$\therefore \frac{P_A}{P_B} = \frac{n_A}{n_B} = \frac{32}{2} = 16$

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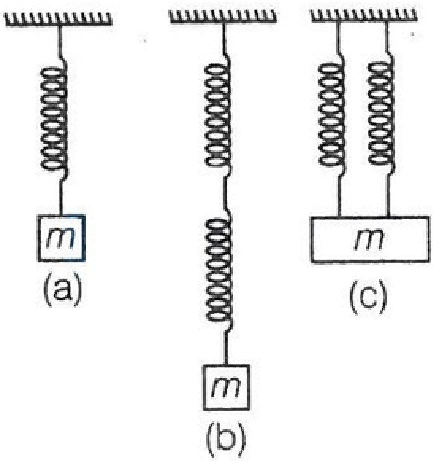

$1 : \sqrt{2} : \frac{1}{\sqrt{2}}$

A. $2 : \sqrt{2} : \frac{1}{\sqrt{2}}$

B. $\frac{1}{\sqrt{2}}$ C. $: 2 : 1$

ADn. s. $2 : \frac{1}{\sqrt{2}} : 1$

A

Solution:

$$T_a = 2\pi\sqrt{\frac{m}{k}}$$

$$T_b = 2\pi\sqrt{\frac{m}{(k/2)}}$$

$$T_c = 2\pi\sqrt{\frac{m}{2k}}$$

$$\therefore \quad T_a : T_b : T_c = 1 : \sqrt{2} : \frac{1}{\sqrt{2}}$$

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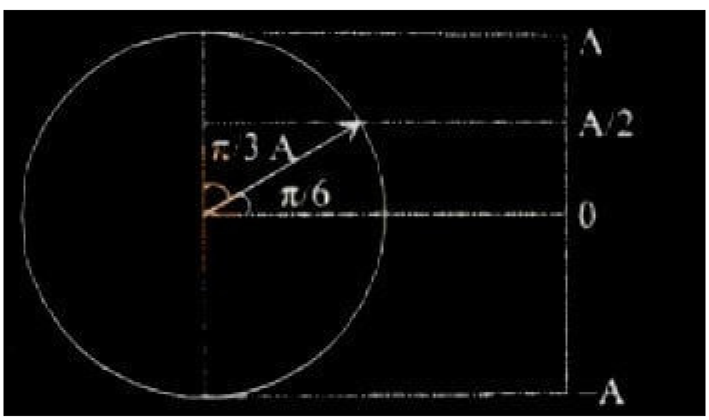

Let time from 0 to $A/2$ is t_1 and from $A/2$ to A is t_2 From the standard equation of SHM,

$\Rightarrow \frac{A}{2} = A\sin(\omega t_1)$

$\Rightarrow \omega t_1 = \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{6}$ ....(i)

Using $x = A_0 \sin \omega t$ again

$A = A \sin \omega (t_1 + t_2)$

$\omega (t_1 + t_2) = \sin^{-1}(1) = \frac{\pi}{2}$

Using (i)

$\omega t_2 = \frac{\pi}{2} - \frac{\pi}{6} = \frac{\pi}{3}$ .....(ii)

Dividing equation (i) by (ii) we get

$\frac{t_1}{t_2} = \frac{1}{2}$

$\Rightarrow \quad t_2 = 2t_1 = 2 \times 2 = 4\text{sec}$

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$$T = 2\pi\sqrt{\frac{l}{g}} \;\&\; g = \frac{GM}{(R+h)^2}$$

$$\therefore T \propto (R+h)$$

$$\Rightarrow \frac{T_1}{T_2} = \frac{(R+h_1)}{(R+h_2)} = \frac{(R+R)}{(R+2R)} = \frac{2}{3} \Rightarrow 3\,T_1 = 2\,T_2$$

en at S.T.P. w ill be approximately:

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At Su.TtiPo n:
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Temperature, $T = 273\ \mathrm{K}$

Molecular mass of oxygen, $M = 32 \times 10^{-3}\ \mathrm{kg}$

Speed of sound is given by

$$v = \sqrt{\frac{\gamma RT}{M}} = \sqrt{\frac{1.4 \times 8.3 \times 273}{32 \times 10^{-3}}}$$

$$= 314.8541 \simeq 315\ \mathrm{m/s}$$

rogressive wave is given by y = 2 cos 2π(330t − x)m. The frequency of

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Equation of wave is, $y = 2\cos 2\pi(330t - x)$ m

$y = A\cos(\omega t - kx)$

On comparing $\omega = 2\pi \times 330$

$2\pi f = 2\pi \times 330 \Rightarrow f = 330\ Hz$

$[\because \omega = 2\pi F]$

g/cm,a utdheieu tehso 1nsμuom mm

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o k 7 3

e, g = 10 ms]

[12 −2

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AD

$E=3.65 \times 10^4 \mathrm{~N/C}, r=1 \mu \mathrm{~m}=10^{-6} \mathrm{~m}$

$$\begin{aligned} \rho_{\text{oil}} & =1.26 \mathrm{~g/cm}^3 \\ & =1.26 \times 10^3 \mathrm{~kg/m}^3 \end{aligned}$$

Since, droplet is stationary hence weight of droplet = force due to electric field

$\Rightarrow \quad \frac{4}{3} \pi r^3 \cdot \rho_{\text{oil}} \cdot g=q E \ldots(i)$

If n be the number of excess electrons in the oil drop, then

$q=n e$

Hence, from Eq. (i), $\frac{4}{3} \pi r^3 \rho_{\text{oil}} \cdot g=n e E$

$$\begin{aligned} \Rightarrow n & =\frac{4 \pi r^3 \rho_{\text{oill}}\, g}{3 e E} \\ & =\frac{4 \times 3.14 \times\left(10^{-6}\right)^3 \times 1.26 \times 10^3 \times 10}{3 \times 1.6 \times 10^{-19} \times 3.65 \times 10^4} \\ & =0.03 \approx 0 \end{aligned}$$

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Sol.:5CV

$\therefore \quad \left(\frac{4}{3}\pi r^3\right) \times 8 = \frac{4}{3}\pi R^3$

$\Rightarrow \quad 2r = R$...(i)

According to charge conservation,

$8q = Q$...(ii)

Potential of one small drop, $V' = \frac{q}{4\pi\varepsilon_0 r}$

Similarly, potential of big drop, $V = \frac{Q}{4\pi\varepsilon_0 R}$

Now, $\quad \frac{V'}{V} = \frac{q}{Q} \times \frac{R}{r}$

$\Rightarrow \quad \frac{V'}{20} = \frac{q}{8q} \times \frac{2r}{r}$ [from Eqs. (i) and (ii)]

$\therefore \quad V' = 5\text{ V}$

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Moalsust ioo fn d: ust particle, m = 4 × 10−12mg

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$= 4 \times 10^{-12} \times 10^{-3}\ \mathrm{g}$
$= 4 \times 10^{-12} \times 10^{-3} \times 10^{-3}\ \mathrm{kg}$
$= 4 \times 10^{-18}\ \mathrm{kg}$

Electric field, $E = 50\ \mathrm{N/C}$

Weight of dust particle, $W = mg$

$= 4 \times 10^{-18} \times 10 = 4 \times 10^{-17}\ \mathrm{N}$

Electric force experienced by dust particle,

$$F_e = qE$$
$$F_e = ne \cdot E = n \times 1.6 \times 10^{-19} \times 50$$

where, n is the number of electrons removed from neutral dust particle.

$\therefore$ At balance condition,

$$\text{Electric force} = \text{Weight of dust particle}$$
$$n \times 1.6 \times 10^{-19} \times 50 = 4 \times 10^{-17}$$
$$n = \frac{4 \times 10^{-17}}{1.6 \times 10^{-19} \times 50}$$
$$= \frac{400}{80} = 5$$

BA. ,. (Ele80c0o0octrNrdicCi −nfa1t8eld 0s at0a0repNCn− c1m)0,30,0) due to a charge of 0.0 08μC p

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C.. $4000(\hat{\mathbf{i}} + \hat{\mathbf{j}})\mathrm{NC}^{-1}$

$200\sqrt{2}(\hat{\mathbf{i}} + \hat{\mathbf{j}})\mathrm{NC}^{-1}$

$400\sqrt{2}(\hat{\mathbf{i}} + \hat{\mathbf{j}})\mathrm{NC}^{-1}$

Sonlsu. tCio n:
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$E=\frac{Kq}{r^2}\cdot\hat{r}=\frac{Kq}{r^3}\cdot r$

Here,

$$r=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2}$$
$$=\sqrt{(30)^2+(30)^2+0^2}$$
$$=30\sqrt{2}\text{ cm}$$
$$=30\sqrt{2}\times10^{-2}\text{ m}$$

$\text{and } q=8\times10^{-3}\times10^{-6}\text{C}$

Also, $\mathbf{r}=(30\hat{\mathbf{i}}+30\hat{\mathbf{j}})\times10^{-2}\text{ m}$

$$\text{So, E}=\frac{9\times10^9\times8\times10^{-3}\times10^{-6}}{\left(30\sqrt{2}\times10^{-2}\right)^3}\times(30\hat{\mathbf{i}}+30\hat{\mathbf{j}})\times10^{-2}$$
$$=\frac{9\times8\times10^9\times10^{-11}}{27\times2\sqrt{2}\times10^{-6}\times10^3}\times30(\hat{\mathbf{i}}+\hat{\mathbf{j}})$$
$$=\frac{9\times8\times10^2\times3}{27\times2\sqrt{2}}(\hat{\mathbf{i}}+\hat{\mathbf{j}})$$
$$=200\sqrt{2}(\hat{\mathbf{i}}+\hat{\mathbf{j}})\text{NC}^{-1}$$

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d4i9s. Eale

As. F(air)=F(medium)

$$\Rightarrow\frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{d_{air}^2}=\frac{1}{K}\frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{d^2}\Rightarrow d_{air}=d\sqrt{K}$$

point charge of 5 × 10−9 C is 50 V. The

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B. 93c
C cm

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S

$$V_P = \frac{KQ}{r}$$

$$\Rightarrow \quad 50 = \frac{9\times10^{9}\times5\times10^{-9}}{r}$$

$$\Rightarrow \quad r = \frac{45}{50} = \frac{9}{10} = 0.9\ m = 90\ cm$$

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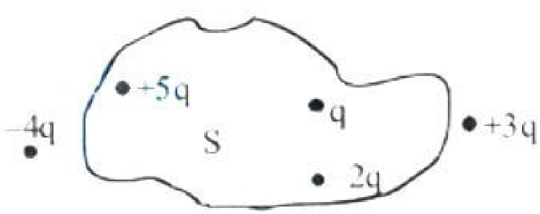

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A //0

AD. 3qq/ Bϵϵ0 0
C..

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Using Gauss's law, $\phi = \frac{q}{\epsilon_0}$

Here, q = charge inside the closed surface

$\therefore \phi = \frac{q+(-2q)+5q}{\epsilon_0}$

$\Rightarrow \phi = \frac{4q}{\epsilon_0}$

citor with plate area A and plate separation d = 2 m has a

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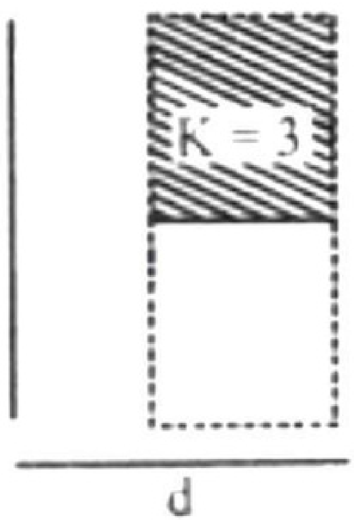

AD.. 632 μF

B. 2μ μF

C.

SonlsutC io n: 8μ

We have, $C_i = \frac{A\epsilon_0}{d} = 4\mu F$

$$C_f = \frac{A\epsilon_0}{d - t + \frac{t}{k}} = \frac{A\epsilon_0}{d - \frac{d}{2} + \frac{d}{2\times3}}$$

$$= \frac{A\epsilon_0}{d\left(1 - \frac{1}{2} + \frac{1}{6}\right)}$$

$$= \frac{4\mu F}{\frac{2}{3}} = 6\mu F$$

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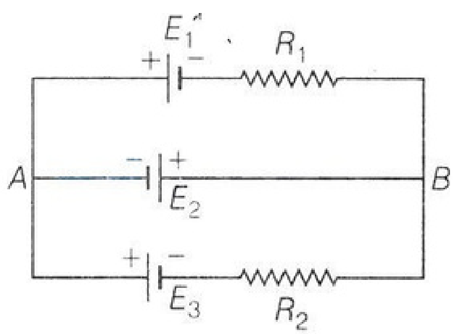
2 = E3 = 2 V and R1 = R2 = 4Ω, then current flowing

AB is = E



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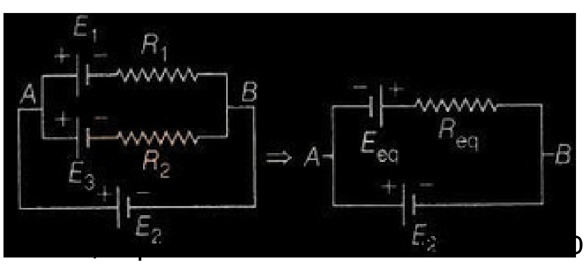
Sn. 5 tBgiiovne:n circuit can be redrawn as,



on,

$$E_{eq} = \frac{E_1 R_1 + E_2 R_2}{R_1 + R_2}$$
$$= \frac{2 \times 4 + 2 \times 4}{4 + 4} = 2 \text{ V}$$

and $R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{4 \times 4}{4 + 4} = \frac{16}{8} = 2\Omega$

Net emf of the circuit,

$$E' = E_2 + E_{eq}$$
$$= 2 + 2$$
$$= 4 \text{ V}$$

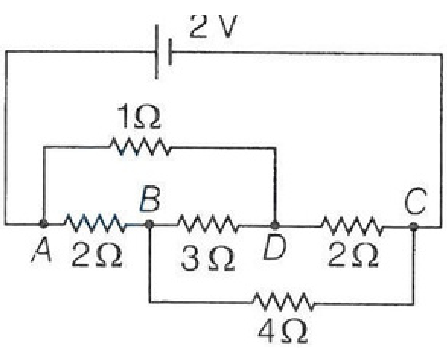
$\therefore$ Current flowing through branch AB,

$$I = \frac{E'}{R_{eq}} = \frac{4}{2} = 2 \text{ A}$$

isl elarly from figure, it is clear th at direction of current is from point A to B clockwise

C

r5e3s.o iIosnpta t.nhcee f oolfl othwei nnge tcwirocrukit diagram, when 3Ω resistor is removed, then e



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HTohleer teeio,quni:v alent Wheatstone's bridge network of the given circuit is shown in figure.

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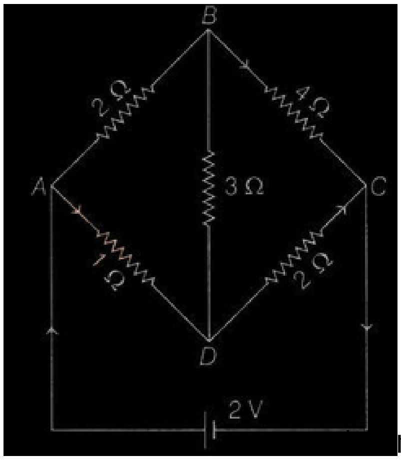

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$V = Al$ or $l = \frac{V}{A}$

$\therefore \quad R = \rho \cdot \frac{l}{A} = \frac{\rho V}{A^2} = \frac{\rho V}{\frac{\pi^2 D^4}{16}} = \frac{16 \rho V}{\pi^2 D^4}$

$\therefore \quad \frac{\Delta R}{R} = -4 \frac{\Delta D}{D} = -4(-0.4) = 1.6\%$

ere 0si srteasnisctea nofc ethe6 w0Ωir eis w m ilel lbteed and drawn in wire o

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T55le.0 A n wefwirΩ f one-fourth of its length.

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DB.

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.6Ω

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Initial length $= l_1$

Final length $= l_2$

Initial area $= \mathrm{A_1}$

Final area $= A_1$

$\therefore$ Volume remains same

$\therefore \mathrm{A_1 l_1 = A_2 l_2} \Rightarrow \mathrm{A_1 l_1 = A_2 \frac{l_1}{4}}$

$\Rightarrow 4\ \mathrm{A_1 = A_2}$

Initial resistance, $\mathrm{R_1} = \frac{\rho l_1}{A_1} = 160\Omega$ (given)

Final resistance, $\mathrm{R_2} = \frac{\rho \mathrm{l_2}}{\mathrm{A_2}}$

$\therefore \frac{\mathrm{R_2}}{\mathrm{R_1}} = \frac{\mathrm{l_2\ A_1}}{\mathrm{A_2 l_1}} = \frac{l_1}{4} \frac{\mathrm{A_1}}{4\ \mathrm{A_1} l_1}$

$\Rightarrow R_2 = \frac{1}{16} R_1 = \frac{1}{16} \times 160 = 10\Omega$

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$I=\frac{nE}{nr+R}=\frac{5E}{5r+R}$ u

In parallel, current through resistance R

$I'=\frac{E}{\frac{r}{n}+R}=\frac{nE}{r+nR}=\frac{5E}{r+5R}$

According to question, $I=I'$

$\therefore \frac{5E}{5r+5R}=\frac{5E}{r+5R} \Rightarrow 5r+R=r+5R$

or $R=r \quad \therefore \frac{R}{r}=1$ atiteh eA pBo cianrtrie P ass a s chuorwr enn itn I .f iTghuer ee. nTdhse o mf tahgen w

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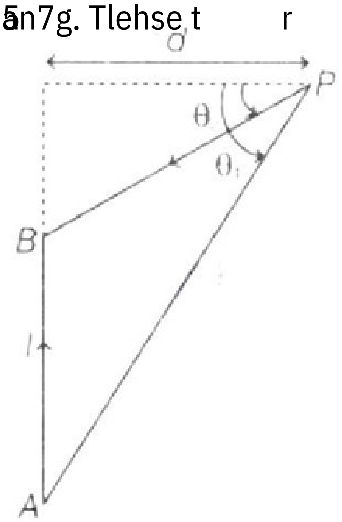

$\frac{\mu_0 I}{4\pi d}(\sin\theta_1-\sin\theta_2)$

A. $\frac{\mu_0 I}{4\pi d}(\sin\theta_1+\sin\theta_2)$

B. $\frac{\mu_0 I}{4\pi d}(\cos\theta_1-\cos\theta_2)$

C.

$\frac{\mu_0 I}{4\pi d}(\cos\theta_1 + \cos\theta_2)$

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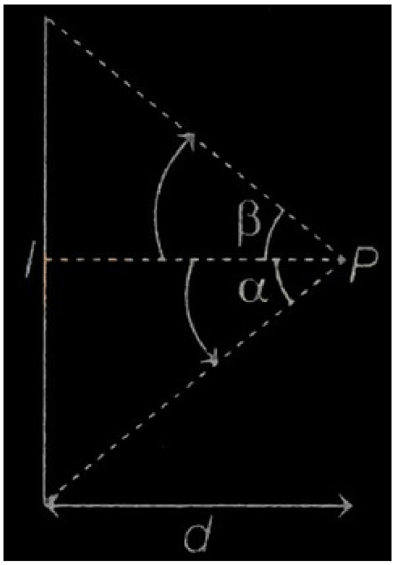
where, d is the distance between the point P and wire.

$$B = \frac{\mu_0 I}{4\pi d}(\sin\alpha - \sin\beta)$$



In the given problem, $\alpha = \theta_1$ and $\beta = \theta_2$

$\therefore \quad B = \frac{\mu_0 I}{4\pi d}(\sin\theta_1 - \sin\theta_2)$ ased i tiwus s icr raeo cissas:r sreiecsti ao nst. eTahdey r cautiror eonf tt h

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Moalguntieotnic: field due to straight wire,

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$B = \frac{\mu_0 I}{2\pi r}$

Magnetic field at $\frac{a}{2}$ is,

$B_{a/2} = \frac{\mu_0 I}{2\pi(a/2)}$

$\therefore \frac{B_{a/2}}{B_{2a}} = \frac{1}{1} = 1:1$

m59o. vTinheg ewleitcht rvoesltoactiitcy f vo rccaen be writtaecn: $\left(\vec{F}_1\right)$ and magnetic force $\left(\vec{F}_2\right)$ acting on a charge q

A

$\vec{F}_1 = q\vec{V}\cdot\vec{E}, \vec{F}_2 = q(\vec{B}\cdot\vec{V})$

C.

B.. $\vec{F}_1 = q\vec{B}, \vec{F}_2 = q(\vec{B}\times\vec{V})$

$\vec{F}_1 = q\vec{E}, \vec{F}_2 = q(\vec{V}\times\vec{B})$

$\vec{F}_1 = q\vec{E}, \vec{F}_2 = q(\vec{B}\times\vec{V})$

Son lsu. tCio n:
D.

Electrostatic force, $\vec{F}_1 = q\vec{E}$

Magnetic force, $\vec{F}_2 = q(\vec{V}\times\vec{B})$ of r adius 0.5 m , magnetic field is changing at a rate of 50 ×

60. Inside a solenoid
cc−e6 at.ion o an electron placed at a distance of 0.3 m from axis of solenoid will be
A1063 er/

.3 ×× × 1106 10mm0 m/sfss2

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B

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109 m/s2

D. 2 × 10 9
Ans: A

Sol: The changing magnetic field induce an electric field which will accelerate the electron. The acceleration of electron will be

$a = \frac{eE}{m} \quad [\because F = qE]$

To find electric field E, we will use Faraday's electromagnetic induction.

$\text{emf}, \varepsilon = \frac{-d\phi}{dt}(B \cdot A)$

where, B is the magnetic field and A is the area of cross-section.

$\varepsilon = -A \cdot \frac{dB}{dt} = -\pi r^2 \frac{dB}{dt}$

Now, electric field, $E = -\frac{\text{emf}}{\text{distance}} = -\frac{\varepsilon}{d}$

$= \frac{\pi r^2}{d} \frac{dB}{dt}$

Now, acceleration, $a = \frac{e}{m} \frac{\pi r^2}{d} \frac{dB}{dt}$

$= \frac{1.6 \times 10^{-19}}{9.1 \times 10^{-31}} \times \frac{22}{7}$

$\times \frac{(0.5)^2}{(0.3)} \times 50 \times 10^{-6}$

$= 23 \times 10^{6} \text{ ms}^{-2}$ acnntad nc nocue-am txobi aetlhr s eoo sfl eetnulfor-inindsds pu oecfrt s auannm

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$\frac{n_1}{n_2}$

B.

$\frac{n_2}{n_1} \cdot \frac{n_1}{r_2}$

C.

$\frac{n_2}{n_1} \cdot \frac{r_2^2}{r_1^2}$

$\frac{n_2}{n_1}$

Tomls. D eu triao tne :o f mutual inductance is given by

A.

S

$$\mathbf{M} = \mu_0 \mathbf{n}_1 \mathbf{n}_2 \pi\ \mathbf{m}_1^2 \text{ ....(i)}$$

The rate of self inductance is given by

$$\mathbf{L} = \mu_0 \mathbf{n}_1^2 \pi \mathbf{r}_1^2 \text{ .....(ii)}$$

Dividing (i) by (ii)

$$\Rightarrow \frac{\mathbf{M}}{\mathbf{L}} = \frac{\mathbf{n}_2}{\mathbf{n}_1}$$

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CBA

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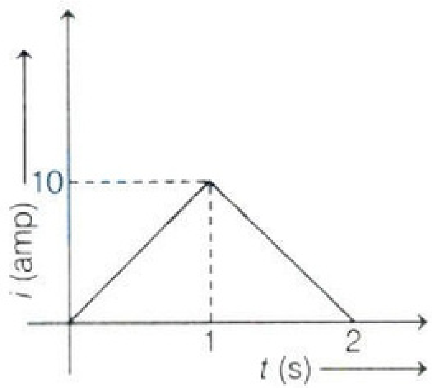
63. Find the average value of cur rent shown graphically from t = 0 to t = 2 s.

$$\text{Average emf, } e = \frac{\text{Change in flux}}{\text{Time}} = -\frac{\Delta\phi}{\Delta t}$$

$$= -\frac{0-(4\times(2.5\times2)\cos 60^\circ)}{10} = +1\ \mathbf{V}$$



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Sonlsu.AA tB io n:
B..

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From $i - t$ graph, area from $t = 0$ to $t = 2$ s, we get

$$= \frac{1}{2} \times 1 \times 10 + \frac{1}{2} \times (2 - 1) \times 10$$
$$= 5 + 5 = 10 \text{ A}$$
$$\therefore \text{ Area current, } i_{av} = \frac{\text{Area } (i - t) \text{ graph}}{\text{time interval}} = \frac{10}{2} = 5 \text{ A}$$

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$Z=\sqrt{(X_L-X_C)^2+R^2} \quad \because X_L=X_C=R$

$\therefore Z=R$ 5lu0teeΩr i.ns Ta:htien gti mvoel ttaakee nV (fto)r =th 2e2 c0 u rsrine n1t0 t0oπ rti sveo flrt ois

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$t=T/6$

$t=\frac{2\pi}{6\omega}=\frac{\pi}{3\omega}=\frac{\pi}{300\pi}=\frac{1}{300}=3.3\ \mathrm{ms}$

Here $\omega=100\pi\,\mathrm{rad/s}$ tc ditiosrta cnocn es. is

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66. 1A 52 a Aesdl pblya tae schaopnta $\frac{dE}{dt}=6\times10^{12}\ \frac{V}{m\times s}$, Ifth eselonef cthttrwet cov fcraieilulcued .1ar ey
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Given, area of plates, $A = \pi R^2 = 3.14 \times (0.1)^2 \ \mathrm{m}^2$ and $\frac{dE}{dt} = 6 \times 10^{13} \frac{\mathrm{V}}{\mathrm{m} \times \mathrm{s}}$

Displacement current between the plates,

$$I_d = \varepsilon_0 \frac{d\phi}{dt}$$

$$\Rightarrow \quad I_d = \varepsilon_0 A \left(\frac{dE}{dt}\right) \quad \left[\because \frac{d\phi}{dt} = A\frac{dE}{dt}\right]$$

$$= 8.85 \times 10^{-12} \times 3.14 \times (0.1)^2 \times 6 \times 10^{13}$$

$$\Rightarrow \quad I_d = 16.67 \text{ A}$$

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$v = \frac{C}{\sqrt{\mu_r \epsilon_r}}$

$\Rightarrow 1.5 \times 10^8 = \frac{3 \times 10^8}{\sqrt{2 \times \epsilon_r}}$

$\Rightarrow 2\epsilon_T = 4 \Rightarrow \epsilon_T = 2$

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i.e $P = \frac{1}{f}$, where f is focal length of equiconvex lens.

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$$P' = \frac{1}{f} \Rightarrow P' = P$$

$$\Rightarrow \quad \frac{P'}{P} = 1$$

$$\Rightarrow \quad P : P = 1 : 1$$

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$$\Rightarrow \quad \frac{f_0}{f_e} = 9$$

$$\Rightarrow \quad f_0 = 9 f_e \ldots (i)$$

Distance between objective and eyepiece is given as

$$f_0 + f_e = 20 \ldots (ii)$$

$$\Rightarrow \quad 9 f_e + f_e = 20$$

[from Eq. (i)]

$$\Rightarrow \quad 10 f_e = 20$$

$$\Rightarrow \quad f_e = 2 \text{ cm}$$

$$\therefore \text{ From Eq. (i), } f_0 = 9 \times 2 = 18 \text{ cm}$$

$$\therefore \quad \frac{f_0}{f_e} = \frac{18}{2} = 9$$

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$\because f_0 + f_e = 30$

And magnification, $m = \frac{f_0}{f_e}$

$2 = \frac{f_0}{f_e} \Rightarrow f_0 = 2f_e \Rightarrow f_0 + \frac{f_0}{2} = 30 \therefore f_0 = 20cm$

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$\therefore \mathrm{m} = 2 = \frac{-\mathrm{v}}{\mathrm{u}}$

$2 = \frac{-(15-u)}{-u}$

$2u = 15 - u$

$3\mathrm{u} = 15 \Rightarrow \mathrm{u} = 5\ \mathrm{cm}$

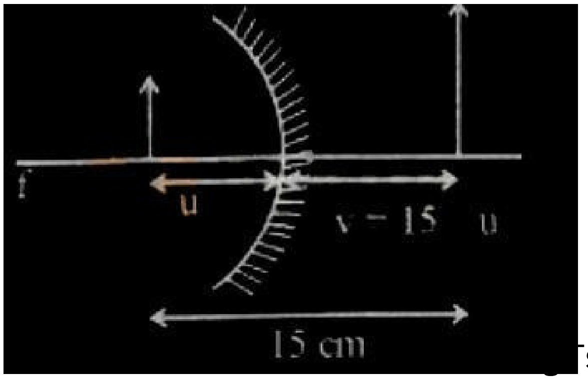
$\mathrm{v} = 15 - \mathrm{u} = 15 - 5 = 10\ \mathrm{cm}$

Bymirror formula,

$\frac{1}{\mathrm{f}} = \frac{1}{\mathrm{v}} + \frac{1}{\mathrm{u}}$

$= \frac{1}{10} + \frac{1}{(-5)} = \frac{1-2}{10} = \frac{-1}{10}$

$\mathrm{f} = -10\ \mathrm{cm}$



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Solu. t ion:

Given, path difference, $\Delta x = \frac{\lambda}{4}$

Phase difference, $\phi = \left(\frac{2\pi}{\lambda}\right) \times$ (Path difference)

$= \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2} \ldots (i)$

It is given that, maximum intensity is I_0. So, intensity at a point on the screen, where phase difference ϕ is given by

$$I = I_0 \cos^2\left(\frac{\phi}{2}\right)$$

$$= I_0 \times \cos^2\left(\frac{\pi/2}{2}\right) \quad [\because \text{ using Eq.(i)}]$$

$$= I_0 \times \left(\frac{1}{\sqrt{2}}\right)^2$$

$$= \frac{I_0}{2}$$

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$y_1 = \frac{\lambda D}{d}$

Position of second bright fringe,

$$y_2 = \frac{2\lambda D}{d}$$
$$y_2 - y_1 = \frac{2\lambda D}{d} - \frac{\lambda D}{d}$$
$$y_2 - y_1 = \frac{\lambda D}{d}$$
$$or \lambda = \frac{(y_2 - y_1) d}{D}$$

Substituting given values, we have

$$\lambda = \frac{0.553 \times 10^{-3} \times 2.08 \times 10^{-3}}{1.8}$$
$$= 639 \times 10^{-9} \text{ m}$$
$$or \lambda = 639 \text{ nm}$$

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For Ist minimad $\sin\theta = \lambda$

$\sin\theta = \frac{\lambda}{a} = \frac{2}{4} = \frac{1}{2} \quad \therefore \theta = 30^\circ$

Angular spread $= 2\theta = 60^\circ$

sperty of light whi ch cannot be explained by Huygen's construction of

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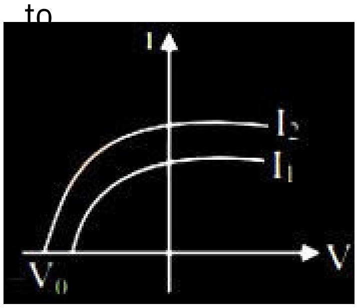

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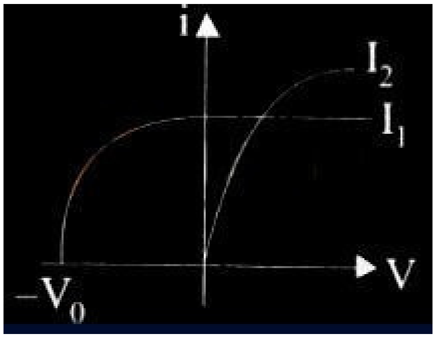
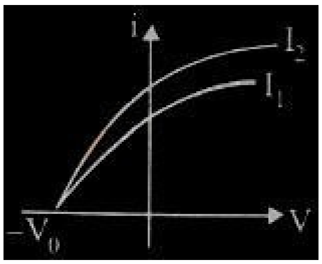
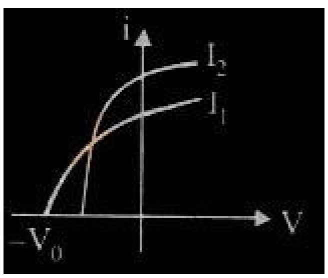


B. 

C. 

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Energy is, $E = \frac{hc}{\lambda}$

$E = \frac{1242\ \text{nm}-\text{eV}}{\lambda} \Rightarrow \lambda = \frac{1242}{6} = 207\ \text{nm}$

n light is incident on a m etal surface the maximum kinetic energy of emitted

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$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2 \cdot m \cdot (K \cdot E)}} \quad \therefore \lambda \propto \frac{1}{\sqrt{K \cdot E}}$

If K.E is doubled, λ becomes $\frac{\lambda}{\sqrt{2}}$

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A. $n = 4$ to $n = 2$

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$= 6$ $= 5$

B. n to n
$= 6$ $= 3$ e of the se

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ne. tthroenn in hydrogen atom (Z = 1) gives wavelength λ1 for tiotr:na fnrsoimtion n2 of toel1c

$\frac{1}{\lambda} = RZ^2\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$

Here, $\lambda = \lambda_1, Z = 1, m = n_1, n = n_2$

$\frac{1}{\lambda_1} = R(1)^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Now, if electron makes transition in He^+ ion from n_4 to n_3 and gives wavelength λ_2, then

$$\frac{1}{\lambda_2} = R(2)^2\left(\frac{1}{n_3^2} - \frac{1}{n_4^4}\right)$$
$$= R\left[\frac{1}{\left(\frac{n_3}{2}\right)^2} - \frac{1}{\left(\frac{n_4}{2}\right)^2}\right]$$

Given that, $\lambda_1 = \lambda_2$

$$\Rightarrow R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R\left[\frac{1}{\left(\frac{n_3}{2}\right)^2} - \frac{1}{\left(\frac{n_4}{2}\right)^2}\right]$$

On comparing beth sides, we get

$n_1 = \frac{n_3}{2}$ and $n_2 = \frac{n_4}{2}$

The value of n_1, n_2, n_3 and n_4 must be an integer, as they denote principal quantum number.

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D. 2::1

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$$\frac{1}{\lambda} = Rz^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Shortest wavelength for Balmer series:

$$\frac{1}{\lambda_B} = Rz^2\left(\frac{1}{2^2} - \frac{1}{\infty}\right)$$

Shortest wavelength for Lyman series:

$$\frac{1}{\lambda_L} = Rz^2\left(\frac{1}{1^2} - \frac{1}{\infty}\right) \text{ ....(ii)}$$

Dividing eq. (i) and (ii),

$\lambda_A : \lambda_1 = 4:1$ imum excitation e nergy of an electron revolving in the first orbit of

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$$E_n = \frac{-13.6eV}{n^2}$$

Excitation energy of electron from $n = 1$ to $n = 2$

$$E = -13.6\left[\frac{1}{2^2} - \frac{1}{1}\right] = -13.6\left[\frac{1}{4} - \frac{1}{1}\right] = 10.2eV$$

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A4 lsu. 5tCio n:

$_6C^{13} +$ Energy $\rightarrow {}_6C^{12} + {}_0n^1$

Mass defect, $\Delta m = (12.000000 + 1.008665) -$ 13.003354

$= -0.00531u$

$\therefore$ Energyrequired $= \Delta m \times 931.5 = 0.00531 \times 931.5$

$MeV = 4.95MeV$

A85. The nucleus having highest binding energ y per nucleon is

$^{16}_{8}O$

..$^{56}_{26}Fe$

B $^{208}_{84}Pb$

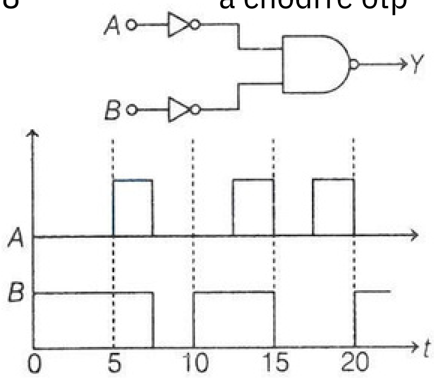
AD6. $^{4}_{2}He$

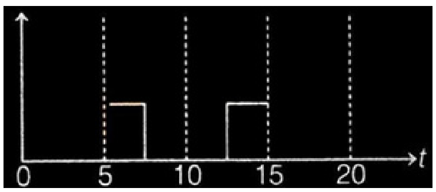
Tonlsu. Bn:

Suhcel tebioii nodf imnga sesn neurgmyb peerr i nn urcalnegoen 3is0 p<r aAc t<ic a1l7ly∘. ind ependent of the atomic number for

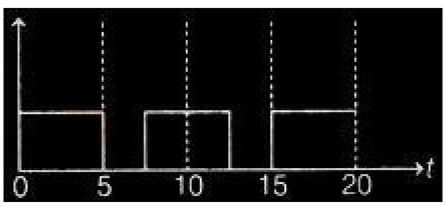
So, $26^{Fe^{56}}$ has maximum binding energy per nucleon.

schtowun uint higen faigl uYr ien. the given combination of gates for the
gi6v.e Ind einnptiufyBts tAhe
8 a cnodrre otp ts



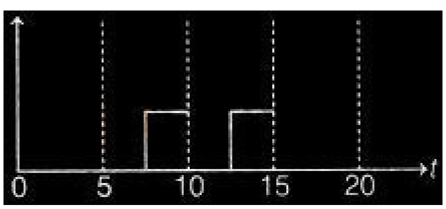


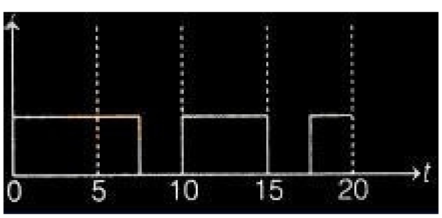
A.



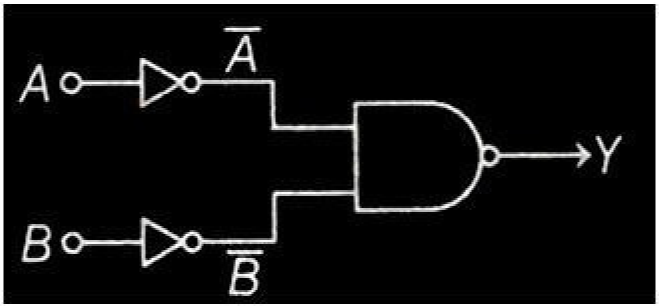
B.

C.



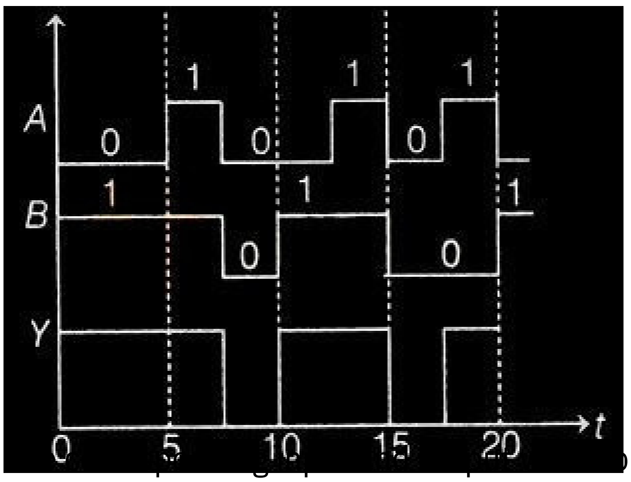


Goilsu. D
SAoD.
venti ocnir:c uit can be shown as below



Output, $Y = \overline{(\bar{A})(\bar{B})} = \bar{A} + \bar{B} = A + B$

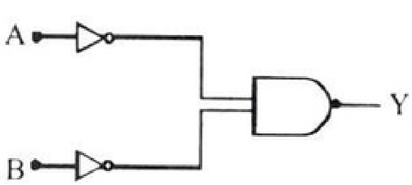
The truth table will be



rms are shown below.

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

it:



ate

BC. . NAONRA ND gate gat

A. N

Sonlsu.O RtBio n:

Output $\mathbf{Y} = \overline{\overline{\mathbf{A}} \cdot \overline{\mathbf{B}}} = \overline{\overline{\mathbf{A} + \mathbf{B}}}$ (ByDe-Morgan Law)

$\therefore Y = \mathbf{A} + \mathbf{B}$

This Boolean expression represents OR gate.

fe briased zener diode whe n operated in the breakdown region works as

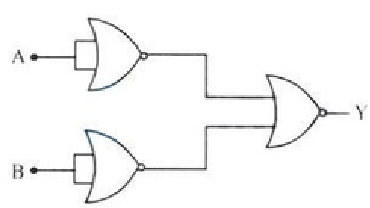
rrer gulator

CB. . a nA aremlstcpeillrlis

AD. aa veotaifgieae tieo

Snls.r c n:

8Ino9 tutC. hIdeioe bnrteifayk tdhoew long riecg oiopner, aat rioevne preserf boriamseedd zbeyn tehr

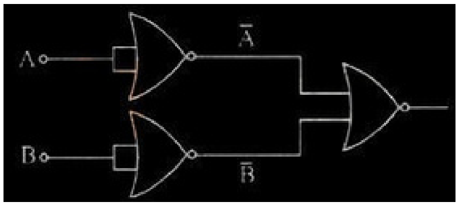


CB NR

D. . NAO.NOATDN D

Sonlsu. tBio n:

A



$$Y = \overline{\overline{A} + \overline{B}}$$

$$= \overline{\overline{A}} \cdot \overline{\overline{B}}$$

$$= A.B$$

So, $Y = A \cdot B$

Therefore gate is AND gate

v9e0a. inOni nesrec acmlaela icipnoe isrnc icasil:dee d s iwviistihon o

(n +f a 1 v)ethr ndiievris ciaolnip oefr v iesr enqieura ls ctoal me, tuhnei tlse

o

m

B..r $\frac{n}{(n+1)}$

A $\frac{m}{(n+1)}$

C $\frac{1}{(n+1)}$

$\frac{m}{n(n+1)}$

Goivlu. Bentio 1n M: ain scale division = m

AD. s

$$nMSD = (n+1)VSD$$

$$\Rightarrow \quad 1VSD = \frac{n}{n+1}MSD$$

Least count of vernier caliper $= 1MSD - 1VSD$

$$\Rightarrow \quad L.C = m - m\left(\frac{n}{n+1}\right) = \left(1 - \frac{n}{n+1}\right)m$$

$$= m\left(\frac{n+1-n}{n+1}\right) = \left(\frac{1}{n+1}\right)m \Rightarrow L \cdot C = \left(\frac{m}{n+1}\right)$$

Chemistry

27urCeio sf [4Asgs oufm mee itdheaanl eb aenhdav 4io.4u gr ooff gc

A1b.e1 L 6ps rcaesmsuedre f liansskid ceo tnhtea ifnlass ak m atixt∘

.A 28. ttCm . 4 6 . 2 2 . 1 a a a t t m m

B

Sonlsu. tAio n:

no. of moles of $CH_4\,(n_1) = \frac{4}{16} = 0.25$ mol

no. of moles of $CO_2\,(n_2) = \frac{4.4}{44} = 0.1$ mol

Total no. of moles $(n_T) = n_1 + n_2 = 0.35$ mol

$$\therefore \quad P = \frac{0.35 \times 0.082 \times 300}{1} = 8.6 \text{ atm}$$

xpression, the con c

2f. Mtmea wehtiocuhred?e of e it entration of a solution remains independent

BAo

DC.. FNMoeormlalailtiy yty alinty

ARTt oli io

Anlsu. D

∵ lhts atyn:lit-yM seo tlevermnt. in kg

∴ M b dnede pdaystoiredswgeravsoaltufnum

=3. I e atroem. that has energy equal to

ergge cnoen nofaldyerp $\frac{-R_H}{9}$ is (where, RH

86y
d

DC...

Sn. 59 ols.u tDio n:

B

A

The energy is given as, $E = -\frac{R_H}{9} \ldots (i)$

We know that,

$$E_n = -\frac{R_H}{n^2} \ldots (ii)$$
$$n^2 = 9$$
$$n = 3$$

When $n = 3, l = 0, 1, 2$

$(3s, 3p, 3d$ sub-shells$)$

Orbitals present (i.e., degeneracy),

$3s = 1, 3p = 3, 3d = 5$

Total number of orbital present $= 3 + 1 + 5 = 9$

and opfl amnaks cs o(nms)ta ins t10

is

4.h Ief nth, iet sd vea-blureo ginli ete wrmavse olef nitgst hm (ab) tisnepitsa)velocity.

A. $\frac{1}{10}\sqrt{\frac{m}{h}}$

$10\sqrt{\frac{h}{m}}$

B. $\frac{1}{10}\sqrt{\frac{h}{m}}$

C. $10\sqrt{\frac{m}{h}}$

A.

D

Lonsetlu. B tthioe nw: avelength of given particle = x

S

Velocity $(v) = \frac{x}{100}$

Using wavelength formul

$$\lambda = \frac{h}{mv}$$

$$\therefore x = \frac{h}{m\left(\frac{x}{100}\right)}$$

$$x = \frac{100h}{mx}$$

$$x^2 = 100\frac{h}{m}$$

$$\Rightarrow \quad x = 10\sqrt{\frac{h}{m}}$$

sy oofr sbe itc oonfdL iorb o

tom is -5.45×1

?ogen a

-19

A5. Te1 9 eonfe frg ir $_{-18}$ $^{2+}$ ioitn (f ihny Jd)r 0 J. What is the en.rgey

t11100−17

– ..9966422

ADn. −−−3s3.9224 ××× × 100−17−18

B..

Solu. tBio n:

$E_n = -13.6\left[\frac{z^2}{n^2}\right] eV$

$\Rightarrow \quad E_1 = -13.6\left[\frac{3^2}{1^2}\right] \mathrm{eV} = -122.4\mathrm{eV}$

$= -122.4 \times 1.602 \times 10^{-19}\ \mathrm{J} = -1.962 \times 10^{-17}\ \mathrm{J}$ tn igst nth 3e0 k0in0eÃ…ic setnriek regsy ao mf tehtea el msuirtftaecde p. Thho

(d) 4eV 1.3 1V0. WhleJsa) 6.626 3 e

−34

.. 6

Son 0 .0 eeVV V

00

AD..

. 21

lsu tCio n:

$\lambda = 3000\text{Ã}\ldots = 3 \times 10^{-7}\ \mathrm{m}, \phi = 2.13\mathrm{eV}$

K.E. $= hv - hv_0 = hv - \phi = \frac{hc}{\lambda} - \phi$

$= \frac{(6.626\times10^{-34}\times3\times10^{8})}{3\times10^{-7}} - (2.13 \times 1.6 \times 10^{-19})$

$= \frac{1.98\times10^{-25}}{3\times10^{-7}} - (3.408 \times 10^{-19})$

$= (6.60 \times 10^{-19}) - (3.408 \times 10^{-19})$

$= 3.192 \times 10^{-19}\ \mathrm{J} = 2.0\mathrm{eV}$ cle eiptsio vgtterieonvlnye,t ntisah fr ble omydn:i ftfhe ear evhnaeclauet ee V do f vfoi h

CB7. Ackamtnset , wprtea saotf)a v hebaleertngwgeet aehnn ad ts wsmooa

elll.eea vpe e e

$\sqrt{meV}$

o

$\sqrt{2meV}$

V

Dnls2m.

hAoes u Be
A eeVlteio ctn.r:o n of charge ' e ' is passed through ' V ' volt, kinetic energy of electron will

Wavelength of electron wave $(\lambda) = \frac{h}{\sqrt{2m \cdot KE}}$

$\lambda = -\frac{h}{\sqrt{2meV}} \quad \therefore \frac{h}{\lambda} = \sqrt{2meV}$

positive, when

A8. El ecagtaf es ifiymis Oniotiot
anngees itno 2–O O O 2+
... OchO ng

CB chh ss

+

behetBhnio n–:
AnIGu. c

S

Oc

2–

pHscie, sO–handerlgeys toon tgathi(lOa)gree ceyhenilpcte lacrtoico n is tmrgoesp,o artiemilcnehcage is
affinity (EA) is

icauite.

A.o. T1htievo
ie.ee

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in.3Ã(...) o f N3–, O2– and F– are respectively.

9AD. 11.3743,,4110 aiaanddii1

..406

..711

B

11.701 aanndd 11d1

C..

,

u tA6io n:
on 1ls.3

S

8de3c−,Fn(aeZ0dn2s=dieh F9 i)n .acrree aissoee ilne cmtraognnicitsu (d1e0 o ef ltehcet rnouncsl)e aspr ec

−

N

i.e).ar

H

$N^{3-} > O^{2-} > F^{-}$

GB:. monitra $1.71Å\ldots\quad 1.40Å\ldots\quad 1.36Å\ldots$

encua) ri sh cyodrrroegcetn. bonding is found in

A10Ie,enotp iodh(1n

--niitromrr lpphheennooolll

l

ooo

AD. pent

psh tA

Tpremhesa-mniomi-tn oro:tpcruhopleanhroe hnl,y ohdly,rdporg -oneginter bno

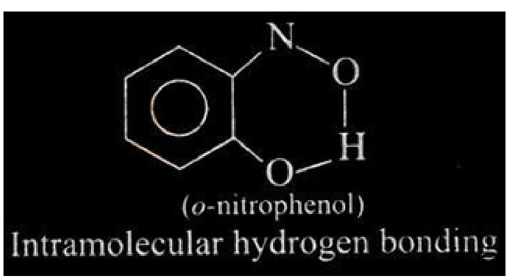
Ion .

o ponhfd eOinn –ogl pHarn ogdrd opuuhcpien nagon ald, s ionixxt eymrgm

Snnnt lour

i setnrtnu.lie

cture is,



he central atom includes a d-orbital contribution

A.inThe hybridisation schem I_3^-

B.. PC l3

Sons. ASe NO_3^-

DC..

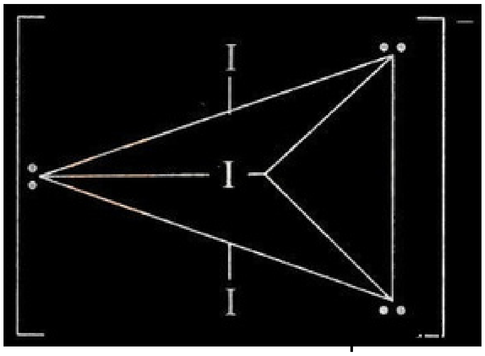
A H2 ution

paiirs lince:ca r w

I_3^-

TThheu sss,ot trhisupinitgh ecqeatraot i undergoing sp3d-hybridisation and three lone d-sorttboointa. l contribution to the hybridisation scheme.

uct sutyrreuricst,uicaldntclrude pinoe iaim



sH2Sdw sit on3

PCl3 sthe2 f-yeollobwi sidnipgseyabm saphn y- hespyebcrniiedsipsa heir. adv we sitahm tew mo laog

NO_3^- spctuhr irs 3- idise loe

Inis f S

(i)2CMNr2i+ 33++

(((iiii)vii)

.i)i)S2 2ncn T3i+++

(vvv)i)

+

(

B 1

DC... 23 4

A

Amlsu.Cotnio gn t:h e given species, Cr^{2+} and Mn^{3+} have same number of unpaired electrons.

Son

A13. 4. The spin only magnetic moment of Fe^{3+} ion (in BM) is approximately.

Unpaired electrons, $n = 4$

CB.. 5 AD. 67

Magnetic moment, $\mu = \sqrt{n(n+2)} = \sqrt{4(4+2)}$

$= \sqrt{24}\text{BM}$

Eleluctrio onn:i c configuration of Fe.

Sons.C

$$_{26}\text{Fe} = [\text{Ar}]3d^6 4s^2$$
$$\text{Fe}^{3+} = [\text{Ar}]3d^5$$

Number of unpaired electrons, $n = 5$

Spin only magnetic moment, $\mu_s = \sqrt{n(n+2)}\text{BM}$

$$\mu_s = \sqrt{5(5+2)}$$
$$\mu_s = \sqrt{35}$$
$$\mu_s = 5.85\text{BM or } \mu_s \simeq 6\text{BM}$$

BA.lcWohnic hre opnuels oiof nths?e following compounds is having maximum 'lone pair-lone pair'

IC3

SFF5 4

C.. IF

A. XF2

Xonls.eu tDio :
D

1. eIdr .uanas
S

othteheF 2eqh ttehrrieael ploonseit ipoanisr sb aencadu tsweo o bf ownhdi cpha tirhse. yT fhaec eth mreaex

ving one ππ-bond and maximum number of canonical

Afo5.r Smse fnrotimf tthhee fsoplelocwieisn hga:

CB. SOO 2 y

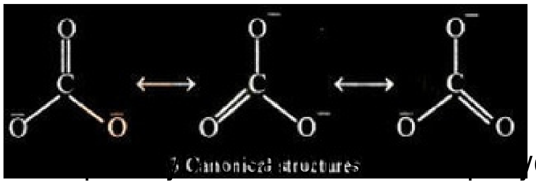
3

D. O2

Sonlsu. D

tio n:

A



yed by :

[SBrFd

5

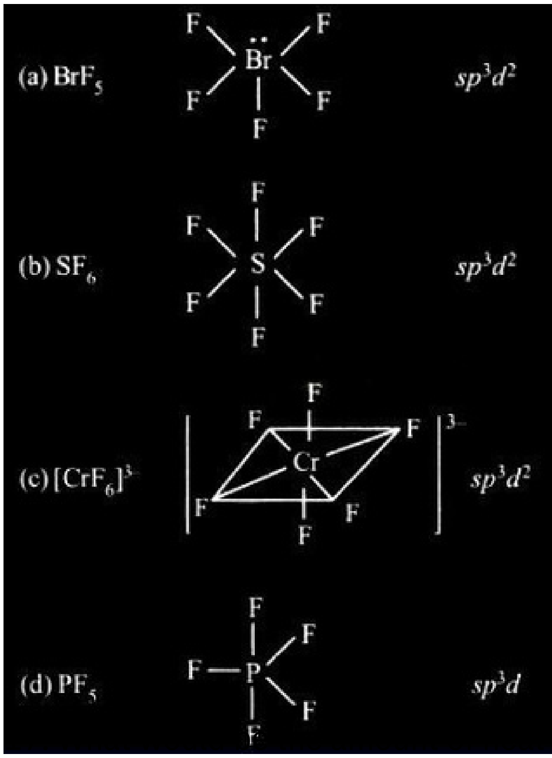
1

F 6]3−

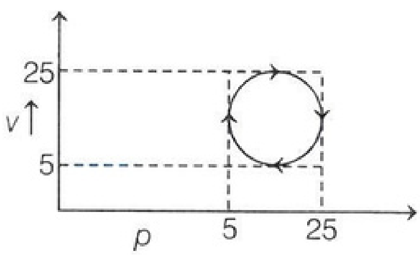
C..CF6
B

Sonlsu.Fr tD5io n:
D . P

A



absorbed in the cyclic process shown below?



.0ππ J J πJ D

A..5π5

ls0

AD.. 211

J

ccauo cto rycndil:nic g ptoro

AInon

S i lasw,in otfe trhnearl menoedrygnya cmhiacnsge = 0

1cset

s

$\Delta U = \Delta q + \Delta W$

As, $\Delta U = 0, \quad \Delta q = -\Delta W$

From the graph, work done $= \Delta W =$ Area under curve Here, area of circle $= \pi r^2$

$$= \pi\left(\frac{25-5}{2}\right)^2 = \pi \times 10^2$$

$\therefore \quad \Delta q = 100\pi$ J

l ofsso X iast −2n0 e0nke Jr/gmy oolf. XTh, eY b oanndd dXiYs saorcei ainti tohne e rnae

t1h8e. Tohe baotnidYn ioi 2 2 w.5 i:l l1 b. eΔH for

A. 2 f0rm

A. 4800000 kJ/mol

kJ/mmolll

BC..

hioe nb:o

SontsD.

otlion energy of X = a kJ/mol

Thee. B Xn d daiss k 2

Let)= = a 0.5m

2 kJ/am ol

anB,E B(EX()=YY)2

Given, $\frac{1}{2}X_2 + \frac{1}{2}Y_2 \longrightarrow XY, \Delta H = -200\ \mathrm{kJ/mol}$

$$\Delta_r H = \mathrm{BE(\ Rreactants\ ) - BE(\ Product\ )}$$

$$\Delta_r H = \left[\frac{1}{2}\mathrm{BE}\left(X_2\right) + \frac{1}{2}\mathrm{BE}\left(Y_2\right)\right] - \mathrm{BE}(XY)$$

$$\therefore -200 = \frac{a}{2} + \frac{0.5a}{2} - a$$

$$a = \frac{200}{0.25} = 800\ \mathrm{kJ/mol}$$

llowing relation is no t correct?

B1.9.ΔWi=h ΔhU o −f te

ΔSUH =svssurq Δ+G W hPΔ Vfo

S

io

A ΔG = ΔH − TΔ

Δ =lsu.

ΔH = U Δ +n :V)e afitn ciotinosnt)a nt pressure

20H = ΔU P (PΔ(BPy

s +t+an dΔaVV

Acon(sa tqnan) e+rgt) By((sΔ),G Kc) =fo r1 t0he2a ftollowing reaction is

(AK(s.)T= +heU 0

15 Jl(ibaqri)d uGbbs2+

eqBu2+i 1

A. c

C0 480k k7J kkJJ

D.. . −−.0 16986

B

C

A Btio

A +lsu. 0

Son −2+n ⇌:

2+ + B

u9 8

=∘ −8.3RT lnA

2c aoiv 6tleu/cs.47 k

(Ro1m. bh.stcliooom× Knn f sbt

c2ombuue1s 4t keim−2ze1)af00 obegn=esnet za(eLnn)te mo CneOs it2sa(−ng

t)3 pa2rn6ed3s.sH9u krOeJ() mwLoilllG− b1ive ae:tn

JK bo(in ton . 5haCt; hheeaatt ooff

c c v

olo)

2562.4 −1m−1

44=13582.14

66

A...

B n. 3−s.3 D26 7.6

ADC

0

Solution:

$$C_6H_6(I) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$$

$$\Delta n_g = 6 - \frac{15}{2} = -\frac{3}{2}$$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$= -3263.9 + \left(-\frac{3}{2}\right) \times 8.314 \times 10^{-3} \times 298$$

$$= -3263.9 + (-3.71) = -3267.6 \text{ kJ mol}^{-1}$$

ree expansion of an ideal gas under adiabatic

2o2dCihtΔioTonsefr,twhe feoicl oowpting: for f

Ac , w ≠ = 0 0l

T= 0 0w, w= = 0 0

B.cq==≠ 00 ,,0Δ,T <≠ 00

AD. qs . = 0,ΔΔT

=

ΔoltDio :

S n

FoUr u =a aqd n+ia wba tic process,

$$q = 0$$

n of ideal gas p0 = 0

FΔoUr =fr ewe =ex −papnexsΔiov

$$\Delta U = w = 0$$

As ΔU = CΔT = 0

$\Delta T = 0$

e is not applicable to

A3 . FLeg(l)s ha s ge) l p2 ⇌ Hinc

B. 2 (Is(gip))l

DC.N2(gg)) ++ ++ S 3(OH(2)(gg) F eS ⇌ ⇌ 2 2NNOH (g3

A N(2

L-Ctho 2

Sonlsu. B

iiaetnne:cli

exe ee rn egqiribpllee c ihsannogte a ipnp cliocnacbelen ttroa ptiuorne d suorliidnsg acnhdem liq

4p.er

2 The ratio $\frac{K_P}{K_C}$ for the reaction

$CO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons CO_{2(g)}$ is:

B. (RT)$^{1/2}$

A. 1RT

ADC. 1

io n:

Sonlsu./ tDvRT

$CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$

K_P and K_C are related as

$K_P = K_C(RT)^{\Delta n_g}$

$\Rightarrow \quad \Delta n_g = n_P - n_R = 1 - 1\frac{1}{2} = -\frac{1}{2}$

Δn_g for the given reaction $= -\frac{1}{2}$

$\therefore \frac{K_P}{K_C} = \frac{1}{\sqrt{RT}}$

A25 H. The pH of 1 N> aqueoOus solut ions of HCl, CH3COOH and HCOOH follows the order:

H

3

ADn. CHCl3>CHHCOOH >COOH HCCll

CC3

s.H C3Co

d, higher the pH .

TSotrlountienr:

HCeenl sngtcreHec,tCOgOwhaec hicdeisp3Om satch we eoarkdeerr the aci

Hh

er

. ix.1u= He1rHL8s MOpH >O oH

mc6id 2C0OeO a a27tiCeHCl. Ccaidlc iusl amteix tehde w coitnhc 5en0t mraLti oon p ooft paosstaiu

2H.3

C o×4fH. 8 10 0.1−5

a

A α

t m ∘ f

CB.. 0.M

0.34 MM

AD0 s.00.0B2M

FSoolru atnio anc: idic buffer,

$$\mathrm{pH} = \mathrm{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]} \cdots (i)$$ in of

olution = xM 20 mL of 0.1 M acetic

0 m =L o2f0o n×c e.1trt

5ceitd thexM0m pt maslusmila=c tep2atteinxlum×detate s
a 50millimol

$$= 50x \text{ milimol}$$

$$\mathrm{pH} = 4.8(Given)$$

Substitute all value in eq. (i),

$$4.8 = -\left(\log 1.8 + 10^{-5}\right) + \log \frac{50x}{2}$$

$$\log 25x = 0.06$$

$$x = 0.04\mathrm{M}$$

27. What is the stoichiometric coeff icie

nt of SO2 in the following balance reaction?

$$\mathrm{MnO_4^-}(aq) + \mathrm{SO_2}(g) \longrightarrow \mathrm{Mn^{2+}}(aq) + \mathrm{HSO_4^-}(aq)$$

ic solution)

A. 34
An. 5 acid

Oon2 xls.iu tAdaito ino:n half reaction:

S

$$SO_2(g) + 2H_2O(l) \longrightarrow HSO_4^-(aq) + 3H^+(aq) + 2e^- \ldots (i)$$

Reduction half reaction:

$$MnO_4^-(aq) + 8H^+ + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l) \ldots (ii)$$

Multiply eq. (i) by 5 and (ii) by 2 and then add

$$2MnO_4^-(aq) + 5SO_2(g) + 2H_2O(l) + H^+(aq) \longrightarrow 2Mn^+(aq) + 5HSO_4^-(aq)$$

Thus, the stoichiometric coefficient of SO_2 in the above balance equation is 5 .

inlu aticoidnice mqueidrieudm t ois r.eact comple tely

umof M8K O4 so

8thVo. 2l m5.0e¢4M Fne/OS

2/8. 4 r

A.i 15.00mL

B L

CD. 15.00 mmL

e thi aolna:n ce ionic equation for the reaction is

Tohls0u. D

S n

$$MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

From the above equation it is clear that 1 mole of $KMnO_4 = 5$ moles of $FeSO_4$.

Apply molarity equation to balance the redox reaction

$$\frac{M_1V_1}{n_1}(KMnO_4) = \frac{M_2V_2}{n_2}(FeSO_4)$$

$$\frac{1 \times V_1}{8 \times 1} = \frac{1}{4} \times \frac{25}{5}$$

$$V_1 = \frac{1 \times 25 \times 8}{4 \times 5}$$

$$V_1 = 10\ cm^3 \text{ or } V_1 = 10.0\ mL$$

re9a. cWtiohnic?h of the following is only a redox reaction but not a di sproportionation

3+4+ PH3

B.. 4HH3PO→3 →

A 8NSOaHO2+H3BPHPO C2Ol →+ 23Na2

P+2O 2 2 2 S2CHlP2 +O 4+SO PH

. P24

2 2 3

TConlsu. +3

AD 4 2 3

thte r ea c:t

tDion

Tshaeus,o itf Pis i foarn P 2 22 2 ivolves change of oxidation

S

orme 0 +do xto8S r e+Oa3Clct aionnd bthuaCt tn olof +t Sa fdroSCismpr l+o4+po t 4Srot O

4 2 → 4P3

l hsaeinoer rheycdt rsitdaetes mweitnht ss iagrnei ficant covalent character

II. Salt,Boy dHgnd pidMls gowaHre

30. A o 2a ge ra ll c

I

ftorymn u-lar feocri sce h vorroymdiitudmees h ayrder Lideew iiss CbraHses

h2

ITEei, Ihec

AIVII.

y h

CB..I,I ,I VIIVI o onnly

nolnyll y

SD. II AonalsIu.I , I Vo

intCio n

y:d rides are not volatile as the strong ionic bonds keep the constituent ions

S

ste hsetra.

Tohgl e h

t t.

Tlheuucatp,eesmr1iscieinnste 3hI yisd irnidccoeosr r rrliecekcet. CH4. SiH4. act as pH - neutral species.

E

a3c1i.d Iinc ,w alhkiaclhin oef othre n feoulltorwal imnge dreiuamcti)o?ns of H2O2 acts as an oxidising

(i) $2Fe^{2+} + H_2O_2' \rightarrow$

(ii) $2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow$

(iii) $I_2 + H_2O_2 + 2OH^- \rightarrow$

(iv) $Mn^{2+} + H_2O_2 \rightarrow$

,(ii))

)... ((ivi(iiiiv))

DC...((iii)i)

B

. i)

e sio cno:m plete the reactions:

Lon.i tlsuutB

A

S

(i) $Fe^{2+} + H_2O_2 \longrightarrow Fe^{3+} + H_2O$

(ii) $\overset{+7}{MnO_4^-} + H^+ + H_2O_2 \longrightarrow Mn^{2+} + O_2 + H_2O$

(iii) $I_2 + H_2O_2 + OH^- \longrightarrow I^- + O_2 + H_2O$

(iv) $Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + OH^-$

Hng2O a2g, eanctt sa amso onxgid tihsein fgo lalogwen

...S bHHhBN

33

A

CB

SonlsHu3 tC io n:

AD. PH33

from NH to BiH but their reducing character

.r Tehatsee cso rorewcnt otyhrdeerr oofu mp.ee lting points of the following salts is

Trhse3 stabili dty of hdr gides dcreases

3i

LiCl LiF LiI

I II III

C. II > I>> IIIIII

sII > III> >

BA. I

III >> II

Sn. B I

D. III h e

A.

mSolutlilineornt:

eedlet i ncingv d paeoleteinrttg ceofhn atlirthaiutemr asanldts h

A4.S. Whgcpn stezoHna tchse,ito fohntlo owrdainelgrle or iisf sums

mho ai

3 . CSaiiumisatcarnoatget

D.. Sooddi

Asoldcimm lsaturayrla steeu lphate

B

C uu

SoodlitDuimo n s: tearate is used in soap and sodium lauryl sulphate

Snu.

$CH_3(CH_2)_{10}CH_2 - OSO_3^{\ominus}Na^{\oplus}$ is an anionic detergent

mposition of lithium ni trate gives

A3.5Li2O, rOd2, NOeco 2O

2

N2

2

An. L2DO, O2, NO2

Solsiu. tio n:
D

$$LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$$

36. The number of geometrical isomers possible for the compound, $CH_3CH = CH - CH = CH_2$ is

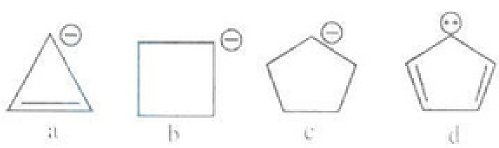
C B . . . 3 2

A D . 4

Aou. tAio
Sn6
hiltlsh idolauugnh C

rtlooe mHubposHs n(ad=ne. H.Cd HH oh w e-–a s natomsuefnbIeg)eaietsoCbrnoCeHrcnhdhCap
atboendosr gab
enmce./ , only two geometrical isomers are possible.

37. Correct order of stability of carbanion is



CB... >> AB >> D CC >> > DA B DAC

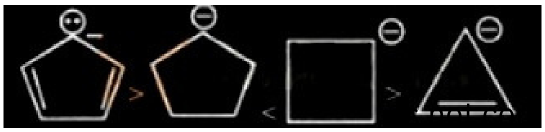
Snls. >D C > B > A

D. D m wuteio knn:

ono

o

tHAgenlcpee osthcue amadwdipo pr ar2y) c(4)(sc3o)n sd rmeisag ((emt3ta4nl)p)d uaonlalr iesgn) te(hb2)e(sl1o)t)e(p)o(a(cid3o1n)sd(sti)o n1bsaanatg bt

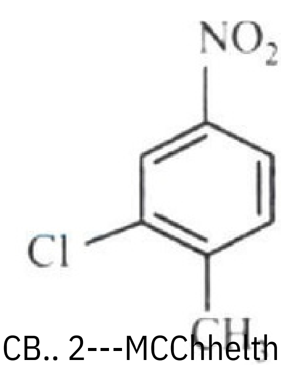
ect about Grignard reagent?

CB3BI.. RtW isohrefaicctshll ea ofowlinlogwing

ADn. It iam atsh nu weorighanomaonngyal ncrobemosep coboumnnpddos u nd t cpcaarhrbbon-ca n o

Solsu. sctDio n:

39. The IUPAC name of th e following molecule is



CB.. 2---MCChhelthloorrool--5-14 mmnietrettoy-1- hhyll--41c--hlonniittroroobenzene rbbeennzzeennee

A. 32 y

o-4 nitro-1-methylbenzene

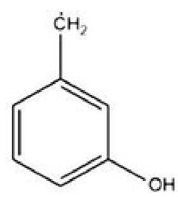
tCio

Ans 2. - Chlor
Sol:u.

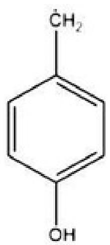
n–uNmO2 anrn:ind Cl a

n as prefixes with CH3 being given the highest preference for

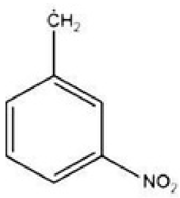
4T0h.ub csn, etohoeg- (C–r1e) w.ritte c en athmee c ofr 1 rheect c sotmabpioliutyn do rwdeilrl boef t2h–e gcihvleonr ofr-1ee-m rad



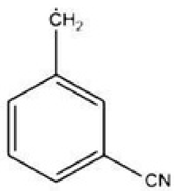
I



II



III



IV

IV

B I>>V I>VI>> I > IIII II

BA. III I > > IIIV>I

ADI. II I= II

Sn.lsu. >

gnnoo cpuotioempn: u

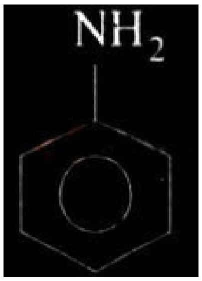
I ooc cessnvItehiefyn(dE)ewirtnd.e iTcafhn ls(eceItu. Vehsf)pofaldbwuitEhCroetasgeMTnheye2 dfecfreferaecw

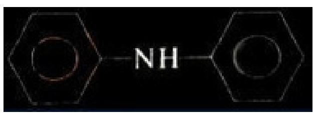
oneipretpsotramtipvoeua anbt dp a(sIrId.ital li ptdso

a) pt hoes iOtiHon a. cTth aiss einleccrteraosne dthoen aetliencgtr gorno udpen tshirt

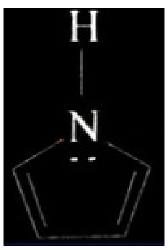
r

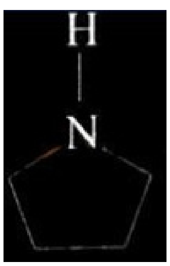
staWillisingIVthlfeaddecea ils. Hence compound (1) is most stabilised. The order of
4I1 > e following is strongest Bronsted base?



A. 

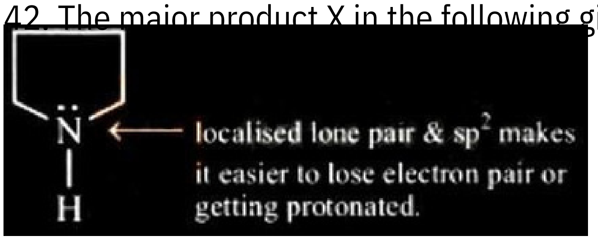
B.

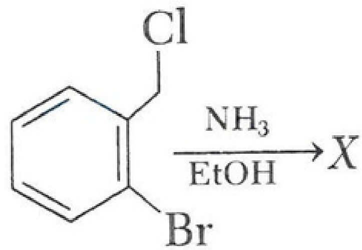


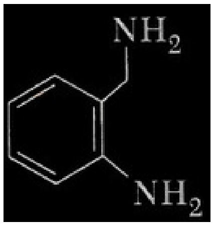
C. 

Sonlsu. tDio n:
AD.

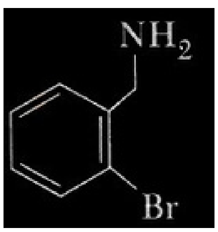
42. The major product X in the following given reaction is

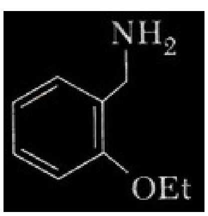






A. 

B. 

C. 

Thheci,e beto re enbn:n z

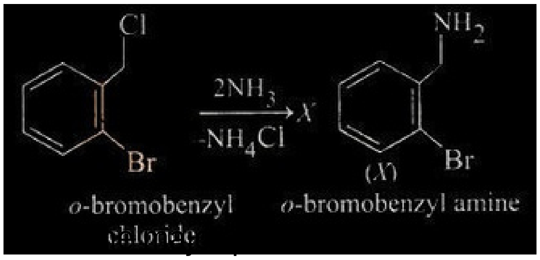
AD.

Solsu. C

tin

,

azecyyilo rafeldaparietore reactive than aryl halides, therefore reaction occur at



n between CH_3CH_2ONa and $(CH_3)_3CCl$ in ethanol

A C

... CCHHCH=C(CO)(C CCHH3C)

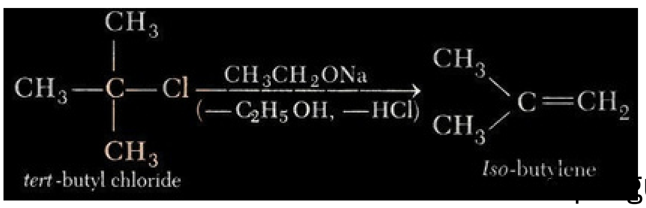
CB 2 32 H

AD CH3 2 33

Ton.erls.H titaio ryn :a lkyl halides readily undergo dehydrohalogenation to form alkenes.

u B

S



guen pdla, bnut tle rae vaecst sa antd h riegtha radlt pithu

ABx4DiNNNOe noift nroitgreong eisn at hrao
OO 3−

Nonls.O

AD. 2(u2C

S gt) i o +n O: 2(g) → 2NO(g)

2t)r ati o2nN Oof2(g) 2 NO damage the leaves and retard the rate of

Assign)yAtoe gacp+eotns(nsOaigsur.→r eso olfu stioolnu tpioonta isss (iRm = f8.3r1o4cJKan−1idme oi
H

dissociated at 300 K. The

u er y

DC.. ..79498

An. 346.

s.2lu. A3

T he 0iore.5aα:c t(i5on0 \in%v odlivsesso cisiated)
αo=t

	$K_4[Fe(CN)_6] \rightleftharpoons$	$4K^+$	$+ [Fe(CN)_6]^{4-}$
Initial moles	1	0	0
Moles after dissociation	$1-\alpha$	4α	α

Total moles at equilibrium $= 1 - \alpha + 4\alpha + \alpha$

Total $= 1 + 4\alpha$

$\therefore$ van't Hoff factor $(i) = \frac{1+4\alpha}{1} = 1 + 4 \times 0.5 = 3$

Osmotic pressure, $\pi = iCRT$

$$C = 0.1\text{M} = 10^2 \text{ mol m}^{-3}$$
$$\pi = 3 \times 10^2 \times 8.314 \times 300$$
$$= 7.483 \times 10^5 \text{Nm}^{-2}$$

or

$\pi = 7.48$ atm

re6as.t u5elr8t.i .nI5dg ge s nootfli ufNytaitoChnle .a cnodr r1e8c0t sgt aotfe gmluecnots re e wgaerro

w4

ieovviona.tiiooonn ooof bbooillii pnngg ippn.ootii nntt..

BC. nNoarnalc soitslo uwtiiol sns hwoiwll gshroewat heerig hbeoirl ibnogi lpinog inptoint

B l e

Son.lsutAio n:

$$58.5\ \mathrm{gNaCl} = \frac{58.5}{58.5}\ \mathrm{mol} = 1\ \mathrm{mol}$$

$$180\ \mathrm{g\ of\ glucose} = \frac{180}{180} = 1\ \mathrm{mol}$$

n

loultio d.o es not dissociates.

BThueNs,aCwel oi aMt Na Cioen ds esisN gMtei goln uCclo .osen

aretipo rne sine nbtosi l:ing point.

epNeamtaCilce nsetnwrait

e miogre ainn

oflla scuotnecnn 1tr gtihoa nv

A7O.cmn 1Lkl b of fdsool ua shelur

ADn. 11. Bolee oooff ssoollvuvenntint iin n 11 kLg o os f fs slootluluo..t

titoio nn..

CB.. 11 mmoollee ooff ssoolluuttee

Ss mo

1olu=tio n:

. 0. WMh1i cmho olef tohfes foolullotew iinn 1g sLu sbosltuatniocne.s show the highest colligative pr

4M8

ABaCl2

DC... 01 00..111 MMM(ugrNNHeOa3 4)3PO4

BA ..

oltD

44.f hntiv: e
Ans.

Coluligiaon

sr is .if or 965 s using 5.0 A

Acu9 T iдeisH, pf0 5d ipl tyndshe1 0 M ocN laiCl thatisgelesulstopolyt(d) consists

uti

AD. 1.3307
B. 110en

C.. 2..
Tonlsu. D.0

he trieo anc:t ion involved is,
1

S

$$NaCl + H_2O \xrightarrow{\text{Electrolysis}} \frac{1}{2}H_2 + Cl_2 + NaOH$$

Amount of NaCl present in 0.5 L of $1.0M, NaCl = 0.5$ mol

Quantity of electricity passed $= 965 \times 5$ coulombs.

$\therefore$ 4825 coulombs will decompose NaCl .

$$= \frac{4825}{96500} \text{ mol}$$
$$= 0.05 \text{ mol}$$

NaOH formed in the solution will also be 0.05 mol .

Volume of solution $= 0.5$ L

$\therefore$ Molarity of NaOH in the solution

$$= \frac{0.05\text{moles}}{0.5 \text{ L}} = 0.1\text{M}$$
$$= 10^{-1}\text{M}$$

$$\therefore \quad \text{pOH} = 1$$
$$\text{or} \quad \text{pH} = 14 - 1 = 13$$

.00/ of Mm o f eO lmeo cftulrorln ict eyal nol dof pam esor4balletsdetu-dlo1A)ersd1wonAeitgea-uhinr

p50ro. dCuaclCctulatHeoel2 t−he 2 n F

005

D.. 6..106 52M 5M

A. CB

As.2A5 M

. 0

Tohleu. toio venr:a ll reaction of H2 − O2 fuel is,

S n

$2H_2 + O_2 \longrightarrow 2H_2O$

Thus $4\ \mathbf{F} = 4 \times 96500\mathrm{C}$ produce water $= 2$ mol $= 36$ g

$$\begin{aligned}\text{Charge actually passed } &= i \times t \\ &= 1 \times 595.1 \times 60 \times 60 \\ &= 2142360\mathrm{C}\end{aligned}$$

$\therefore$ Water produced $= \dfrac{36}{4 \times 96500} \times 2142360$

$\cong 200$ g or 200 mL

$\therefore$ Molarity of NaOH solution $= \dfrac{5}{40} \times \dfrac{1}{200} \times 1000$

$= 0.625\mathrm{M}$ utyn its o pf atsimseed, wthhriocuhg mh ethtael awqiulle boe

B5a1x1g.Wvheuenmn et alhemec tosrauomnlytet o eqnsu ftaohnret t ichtayet ohsfao emdleee?c atrmic

4

C.. FZengCSlO3

AD.. ANN32

Sonlsu.i COtClio n:

$$\frac{\text{Mass of metal}_1\text{ deposited}}{\text{Mass of metal}_2\text{ deposited}} = \frac{\text{Eq.wt.of metal}_1}{\text{Eq.wt.of metal}_2}$$

ea orpatnicoen so.f O is 2 ×

sa.i oTnih e2 SrOate s+il a vpOerpe ⇌ is

1b02 −4eomtioa lcle wnegth of ar 2higas Ssoerao,ttisahecmfuhrnl deis gaipvpe

L

2 2 3 2

−4 oo L−1 −1

3

B. ×m

.. 42 × 111−4 −1 ss−1

10000mmoollllLL

1 s−1

−1 −

ADC. 16 ×

Sonlsu.tBio n:

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

Rate of reaction $= -\frac{1}{2}\frac{d[SO_2]}{dt} = -\frac{d[O_2]}{dt} = \frac{1}{2}\frac{d[SO_3]}{dt}$

Rate of appearance of SO_3,

$$\frac{d[SO_3]}{dt} = 2 \times \left[\frac{-d[O_2]}{dt}\right] = 2 \times \left(2 \times 10^{-4}\right)$$
$$= 4 \times 10^{-4}\ \text{mol L}^{-1}\ \text{s}^{-1}$$

udktJee ms ?roela−c1t rioenspehceti vveallyu, et hoef nA a atn wdh Eat a treem 4pe

9−1Ka

Sd1bren 1 d0r 9 sm

a

p03r1. i3Iof fo afi8t iro6nr , t ×

CBAe... 3303

AD. 3331001. .9K155 KK

AonclscuotDridoinn:g to Arrhenius equation,

S

$\log k = \log A - \frac{E_a}{2.303RT} \ldots (i)$

For 1^{st} order reaction,

$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{600s} = 1.1 \times 10^{-3} \text{ s}^{-1}$

Substitute the value of k in Eq. (i)

$log\left(1.1 \times 10^{-3}\right) = \log\left(4 \times 10^{13}\right) - \frac{98.6 \times 10^3}{2.303 \times 8.314 \times T}$

Solving for T,

$T = 311.15 \text{ K}$ hreea cchtieomn idcaolu rbelaecst iifo tnh Ae c→o nBc,e wnhtraatt iis o nth oef od

Ar ise irncr ethasee rde afocutiro nti?m Geisv.en that, of

54. Aa.te I no ft

AD.: 0. 55

CB.: 12

Sons lu. tCio n:

1

We know, $r_1 = k[A]^n$ ....(i)

If conc. of A is increased four times rate of reaction on doubles.

$2r_1 = k[4A]^n$ ....(ii)

Divide Eq. (ii) by (i).

$\frac{2r_i}{r_1} = \frac{k(4A)^n}{k(A)^n}$

$\Rightarrow \quad 2 = (4)^n \Rightarrow 2n = (2)^{2n} \Rightarrow n = 0.5$ kJ/em tee omthelpe arcattiuvraeti forno m 3e0rg0y K o tf oa 6r0ea0c Kti o.n, whose rate const

55. Aai3s Ci.4n5glc tuhlat en

k6980mol kJ/ A.

961.9 6
CB. .
kJJ//moolll
D.

Sonlsu.tA.io n:

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

or, $\log\left(\frac{2k}{k}\right) = \frac{E_a}{2.303\times8.3} \times \frac{[600-300]}{300\times600}$

$E_a \approx 3.45\ \mathrm{kJ/mol}$ ou

Aof6t. hIne trheea crteioacnt iroenm, aAi n→s upnrcdhanctgse, dIf. tThhee c oorndceern otrf atthieo n

5

CB.. 21

AD.. 00. 5 .

Sonlsu tDio n:

$r_1 = k[A]^n$ and $r_2 = k[2A]^n$

$\because \quad r_1 = r_2 \quad \therefore k[A]^n = k(2[\ A])^n$

or, $\quad 2^n = 1$

or, $2^n = 2^\circ \Rightarrow n = 0$

It is a zero order reaction. ttihme e c otankceenn tfroart tiohne coof nthceen rteraacttiaonnt t, od ec

BC7DA..5i5M mfiirnns u1t5eos rmdeinru rteeasc. tTiohne,
to

ess

CD. 3600 nmuent

lihvsee thtio cn:

u. C

Aonls

S

1/2io

A8.. stT,reh0eiregnsiicn1tdthl3fepst10 Tfe iseuldeenccreenastreast firoonm fr 0o.m8 t0o. 10 .t4o i0n. 012

t 5

temic ltehse solution

6B.. paversel ol fens iezleeyn cotrl

sy sn

ADn. cd'trma bpe omtiionsfe fardro

Tolsau. notC

psa cio frootlrslm o:ai dpthaaelr ptsiaocrulutliatcirloe tnsy. p hTeah voiesf acph rteaefrnegdreee tnn

imohne tn

S

i

Aetx9r Tachtef Secmpa cesitmionsp'slag' formed during the smelting process in the

FCuS2i

CB.. eueO+

AsuF B2S + FeO

D. CC 2

Dulru.itnigo nth: e extraction of copper, iron is present in the ore as impurity (FeS).

Son

2s on Fetiie ogxSa he=e i d3SO Ic t→ai 2sFe sg Ome he a stmitse lwteidth; FseilSic par teos efonrtm a

2

espectively, are

B ZaCmO4, inCCu(aOHO)iCla),3FlFNgeaAndlFdre, r

3 3 2 3 4 3 6

C...

ADn. ZZZnACO3 34 a3A lF6 6

O,3, FFeO eO, ANlNF

4, CCuuCCO3 2 3, 3

alumtio n:
n 2O3

Coals.

MMglaachinte → 3

S

tiitee → ZeCuO O3Cu(OH)2

34

. S. IFn twe h→ic Nh o3fA tlhFe6 following molecules, all bond lengths are not equal?

6 1r ay onl →e

C

C..Pl 5

6

BA

AD.

BCCCC

6n2 P. TCti lon:

l3 4
h5e b so onl dfo lremngetdh i onf t ahxei afol lbloowndin igs ugrnebaatlearn tcheadn e tqhuea lte

Ionls.
S u

Bl

As. 2AOs3 +S H2 S →

A 2 2

2 S3

B

C.. AASss

Son lsu. tB

AD. OW3 o h+c 3 ihH o2f Sth →e fAosll2o Sw3 i+ng 3 hHa2sO l east tendency to liberate H, from miner

A

in:

BA63s. 2

u

ADn. NZin

C.. MC

sn. A

Ino lrueto n

.. Thmtiv: e etiatymeltsa.sel that shows highest and maximum number of oxidation state is:

S enai

6gi4v c ries, Cu lies below Hydrogen and it is least electropositive among the

C.. MFe

BA

AD. TCino

Sonlsu. B

io n:

+i6ng h rsteehssotpw. eOscx thiivdigeahltyie.osnt ostxaidtea toifo+n t

4s, a+te4 o an +d 7+ i6n r3eds pseecriteivse mly.e Otaxlisd. aTtii;o Cno s a

M f

h

try of [Ni(CN)] are

42−

A6sspHyrdb adi staetteripnelanaal r en adnrd geome

..pp3 aannddn eq

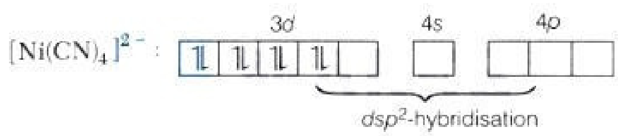
CB ps.s2 andts stuqraauhrared rpalla nar

AD. sd3

Solu ptDio n:

AsCN− is a strong ligand, pairin g of electrons take place, Therefore,

6dIns[pN. i2(MCNh)a4y]t2b−ch,rNi i2L+d=iis3sdt8 4Is0 wonit ghi vLeisst s IqI.uare planar geom etry.



c List I (Complex)		c List II (Oxidation number of metal)	
A.	$Ni(CO)_4$	*I.*	+1
B.	$[Fe(H_2O)_5NO]^{2+}$	*II.*	*Zero*
C.	$[Co(CO)_5]^{2-}$	*III.*	−1
D.	$[Cr_2(CO)_{10}]^{2-}$	*IV.*	−2

swer from the option s given below:

DD-II

BCAo-Ise, B ,tC-Ietr-ItVa,n,

Son.lsIII-,-IIBBI, IC, -CI-VI, DD-IIIII __VII I

C.. A--II

AD AA

u.- tAio n:

6T7h.e W cohrircehc ot fm thatec fho lilso Aw-iInI,g B i-sI ,c Co-rIrVe, cDt -oIIrId. er of ligand field str

CO en $< NH_3$
$<$ 2
$< C_2O_4^-$
2
$< S^-$

A... $S^{2-} < C_2O_4^{2-} < NH_3 < en < CO$

B $NH_3 < en < CO < S^{2-} < C_2O_4^{2-}$

ADC $S^{2-} < NH_3 < en < CO < C_2O_4^{2-}$

seheu. tBie isnio
Son ls

T :

)cnreasing order of field strength of ligands (according to spectrochemical

S^{2-} r $< C_2O_4^{2-} < NH_3 < en < CO$

roir ndgi; sn abtoendd teod i rtoo nir aotno m(II.) ion.

A68. Trine ernreicot sn otrawcteyleonpaldieexcaeygtholi anllngoiswino cnogis

Sn Pe.etBrxeennanatteee ihhaas

BDC. PF o iswis [tXo ral is shape.
5 c
2 22−

Peucio enn: i

Aorls

2

6eroxTehnyaesF ie attlpe neo (fi s η^5 i shpX neh OCisn]Hscinwa nhietdroraple. ntammine chromium (III) chloride is
5)

iloipntnkcizaagte i on

C.9 o.

B.

An. poBymerisation.

[Checi
Dolsu. lt

S (NhoHenm:cal fo ula of nitropenta ammine chromium(III) chloride is:

C crr(an ex3)i5)ist((NNinOf2o)r]m

ow2ig structures
2)l]tCl2rPanrnod twom ium (III) chloride

[P[I

NaaHm35
PCerne(tN3)mnlenOetC2olc

fosmlipet o
ashnNetraaHefomrmONe

5 nrli ocfh roiurmis (I I) c i dthe s

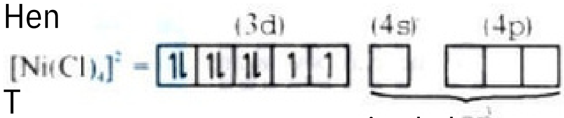
0 greu r i t yt nthkeed fo itshond-nalNmOuriagmgmn,eN ctihfirao,esmtudelgpo
o.am plex
T trha uOisnhe addsr OaNil cOkge isomerism
2
..[[.CNoi(enlt)iofy, p4]2−
BA7 IOd2

CCN2O43]3
AD. [[Ni((C
sNDO))4])]2−

4
C.
Capl)tio
lu. i(C
c aie e [i(
n
S i sN’nn: wi coaNnkfi fCegiuel)gdaNtlliogp4 ib2n+)mais t will not cause pairing of electrons.

42−nxis 2+
(io
isI

Hen



T

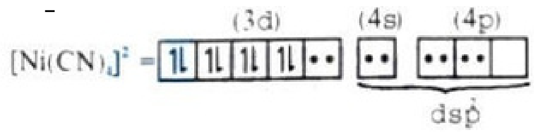
onpaired electron s (i.e., paramagnetic) and

ph3e hyrablr idiitsha ttiwon. u
heatsrsad w

(b) In $\left[Co(C_2O_4)_3\right]^{3-}$, $(C_2O_4)_3^{2-}$ is a bidentate ligand thus, give octahedral structure.

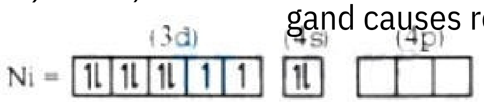
CcN) I nis [aN si(tCroNn)g4]f2i−e,bdNonIrie).gCainusds epaeliring Nwif2 e+lectrons of 3d orbital.

(

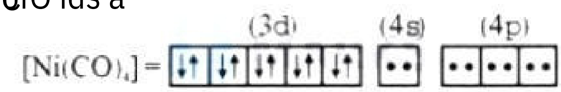


4]c,t Ni ehafs izse srqou oaxried patlaionna rs taanted. iit.e i.s, diamagnetic.

[Nie(C sOtr)uur
(de)n Icne, th o
gand causes re arrangement and pairing of electrons



3 a nsdtr 4osng orfibeiltda ll.i
CfO ids a



. Fe, r(4)o ifns N 4r iesc tte atrnashweedrr.al with sp^3 hybridisation and it is diamagnetic.

81 Sternucctture Hi (hiseC cOor)
.. CFr((nn2 −−ce55)): 2
e t

BA. Fee(enr5o
− C552

. A(n5 −CC5HH5) 5H5) 5 2
5

ADC. Os
elsuto n:

Son

2 reroic clopentadienyl rings coordinated to an Fe^{2+} ion. The hapticity
C. CPSoaoltcauisusmiu hmmexaal
oFt Tachemmiegh aiss two cy
A7 c5 . on is

dhiembeixhaemtanxaphetaeptlcapohpspohhsilptgeatheate

..

B

SonSlso. dtDium hexametaphosphate

D. io :

A7C3alu. gTo ni

piluem w hietxha hmigehtaepsht omsapghnaitteu dwei:tonhetgh(Ay)sfotarlm fiuellad Nspa

rhn(e osmod

6]]3+

x

n. [[sM. m(OHH)]

C... [[FTCer((OOOHH263+

2)6]3+

B

263+

Ssmolo7,pautAio n

AD

S :

6

rgadiuats,r F epol a=r i6zi5npgm p orawdeiru. sT i

Cml rra cs h,n iCes[)Rpct()r2cthNlutoe NasoHMrHdomyandiHt ln=ig)g 6dpe +3

A7. AIUP hCaituios

. rB+da 3+ d maemthe oese=ftf et 6er p +3 iplaC5ds mtl in(Eu +3 =

4 hmilmoiArnmom ao32 nn (admi a(imnemiC 2 3 .

e) dee.

...(iinmeahemaarroeo(((mmmeet))reptthhay Irc (Cl)hhllolo)rr coriididhleo.ride

B DC cchm alattinn(IIV))

AD.Dan. D laammiinn p plla

Sols aCmio n:)

p lei

m75heeut thcao ana.onic complex with two ammine (NH), one chloro (Cl) and one

mT.hstnm, amfexlei focidtlll obwe i:Dngi 3

gehhtiiceh nmg cmommipnleexcheslo wroil l(mexehtihbaitn mamaxinime)u pmla atitntrua

T

2))el th]d?ew a

AB.aW OOfjo

62+

. [[CZnn((HHc

6]2+

o

6]2 +

33+

D.. [[C(NHenO))]

io 2

Aolsu. tB

Stotmraplncte:ioxn w tiot ha nm aapxpimlieudm m naugmnebteirc ofife uldn.paired electron will exhib

$[Zn(H_2O)_6]^{2+} \rightarrow d^{10}$ system $\rightarrow t_{2g}^6 e_g^4$

0 unpaired e^-

$[Co(H_2O)_6]^{2+} \rightarrow d^7$ system $\rightarrow t_{2g}^5 e_g^2$

3 unpaired e^-

$[Co(en)_3]^{3+} \rightarrow d^6$ system $\rightarrow t_{2g}^6 e_g^0$

0 unpaired e^-

$[Ni(H_2O)_6]^{2+} \rightarrow d^8$ system $\rightarrow t_{2g}^6 e_g^2$

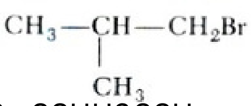
2 unpaired e

76. In SN2 substitution reaction of the type

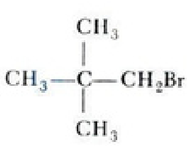
$R-Br + Cl^- \xrightarrow[BMF]{} R-Cl + Br^-$

Which one of the following h as highest relative rate?

A.

B. 

DC.. CCHH3CCH



2CrH 2Br

H2B

3

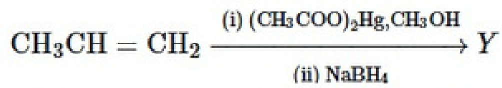
Tolsu. Cetrio tne:

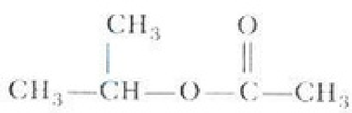
Sn anc o e.f OSnu2

Chih ction is the maximum with 1 allyl halide having least steric

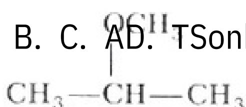
theHc3hCaHg2hBers ta rnedt roefa l aCtHiv3eC rHa2tCeH.2Br, CH3CH2Br has the least steric hindrance and hence has

77. The final product in following reaction Y is,

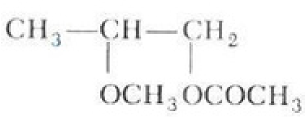


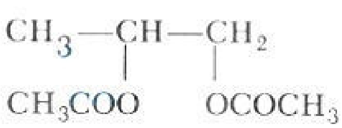


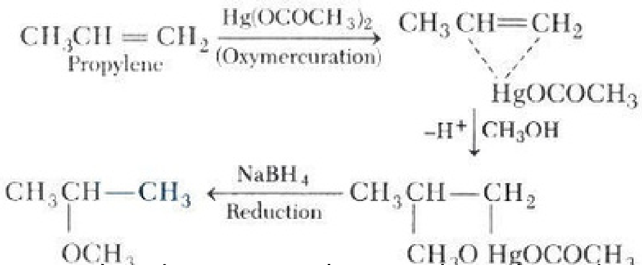
A. B. C. AD. TSonhls.eu tBcioomn:p



lete reaction is as follows,







he Victor-Meyer's test, the colour give n by 1.2 and 3 alcohols are

edc t bcivoeluloly: eu,crlelsosu, blue ° ° °

7e8s. RpInet

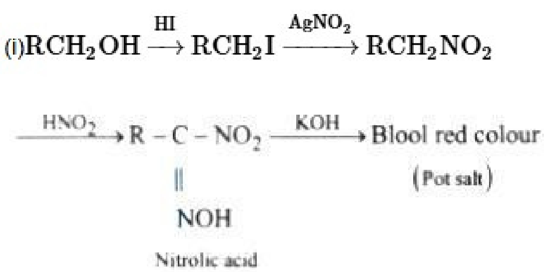
BAr

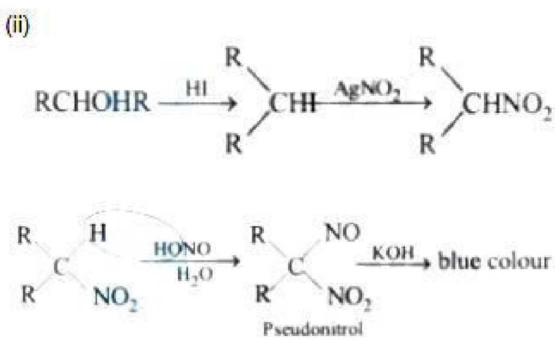
brllueess , v, orioelde,llet rbuses

DC... CRoeldo,,,u

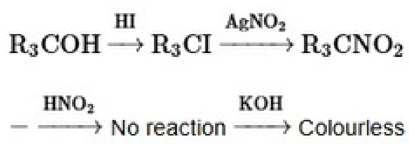
VosiclutotBrio Mn:e yer's test: The various steps involved are

SRn.e d





(iii)



79. What is X in the following reaction?

$CO + 2H_2 \xrightarrow{x} CH_3OH$

B. 623 K / 300 atm

A

C... ZM/nΔO4/H0

ADn. Znn O – Cr2O3, 200 – 300 atm, 573 – 673 K

2car tDi gaoion r

Tols.

fhtohC3ubr5o7me – mno d6os pnexcoan a

e7n8Kdas eTetchhinedhdsi frt ouhemeiafaypatdheoaiottoarngt1 yeso0e.rmsLsainenextvtdeawbtjae b

deea arteyd o wr tiethrt tiharey ". LWuhcaicsh r eaalcgoehlnot"l rteoa dce

a

w8th0ehe. Aal nch oudhncokmo. yns widsrpni macaoyh, osle i scso tanr

aolhcooh ol

tsaettoianrdahlra

boyl by N1

serco

ADn. tee.rctilncardyya raaylcolhcohl boyl bS1SSy 2SN2

C..

N

N

Solsu tBi

rtThehaeec rtraieootanenc: ,ot hifo ernen acoceft atioelcrnot iihaso rdyl i wraeliccthotlh yLo uplc rwao

81. Which of the following will undergo aldol condensation in the presence

A.

DC.. C6 H HO– C– CH O

Son C 3CCH2 HH5

AAnldlsuetDioeh e:

Altd orydno asl dwol iccohn cdoenntsaainti oα-hydrogen atom, i.e. CH_3CH_2CHO will

rauge d . a base to fo arlnmso. a c coanrtbaainn iao nα αa-nhdyd

8cobnsht. dencgth hreongceen d aoteosm n obtu ut ncadnenrgoot baeld e

a laktei obnnye X on ozonolysis gives a mixture of Propan-2-one and methanal. What

As2X?An as

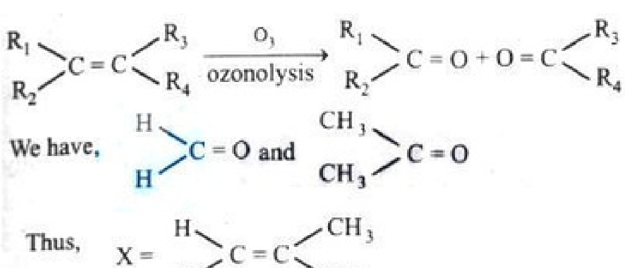
r 2P-ope

B..

C. thhyllplbbutt-pe-12-n-ee ennee thnyeuro

AD. 2 2-MMee

Sonsu.- Met ltBio n:



A83. V. Cithaemilions iAs and digestive disorders are du e to deficiency of

An. RAihsboflici n a cid

B. Tiamine

. orbav
DC.
DolsuctCcio

:

8ef iA itenn (vei tamn 2 sy cchienirea ial,n tdh eve al.i ne. 1

b-etemdfnytponfevoap slsiaidmbelh ineiaeldsoNkeyintuoeqaudseiidngmoeifnsaorlaiamntte,Bsi)caedor i andgce

C

nbu4m. c

t

A

. 84

CB.

.

SectAi ny:
Anlsu.2

n.

(Sonmdeii onatgll,i mnein(
61

(i)Vii Vl-igalrSy-tygvlolctgAadolahbfiboreau lrv, aasleliaqnnuei en(nev ca(elA)s l oafor) r si set hrthien ete
cter la a
(i) i Sael-go

(-Al

BA.ihmi-cVhal-nne o-AAf ltah e follo
8i5v)) W Serr

wing is a water soluble vitamin, that is not excreted easily?
gly

.VVttaami o 2

BnBB 6

B12
CD.Vi.ttaDammiiin

i

:

ex glcrrouod v eitasmlyi.ns and vitamin C are soluble in water except vitamin B12 all are

Bouti

A86m. Geltepnsiadiic li nkage between C1 of α-glucose and C2 of β-fructose is found in

B.. sualytcosse

DC. mcctrooo

Bylsos e
ee

A. laa

onMlsu. tualtioosn:

nit.

S

de nl 1Csα-glucose and C2 of β-fructose.

8-Sacctr ydoseeelpysiadsstidsiydogs ugtlie aagfaecsu

id tnh aCt c oeof n αta-ginlusc oonsely C on of

\- tuurrrcei insg kaamgin boen atcweegcosf

e bαa-sgilcu cfuonsec.t ional group

Ain

4

ienneiucrsaal lslytr oouccd

.
B. itTe mat

ch
layrsg

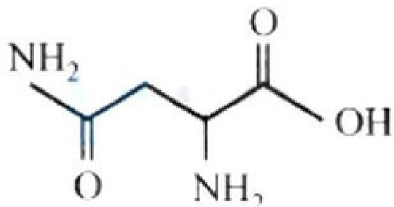
.ip staidra ingiene

DC.. ahssiinne

AonslspuatCrio agni:n e has only one basic functional group in its chemical structure.

A.

S



efomellionwoiancgi dis w niotth am soermei t-hsyannt ohneeti cb apsoilcy fmuenrc?ti

Q88C. Wiarseei-hlu aupocrhe iobfa tsphice

B

ate

alllynoostaineesne oadcitrr

btbee r

AD. CCllV

su ll reu

Son.tAc

eci: r aso?ceptraetnee

8cl.9poiolyn - iasn ntaimtuornayl rturibobxeidr.e catalyst used in the preparation of which

BApyZmin

o

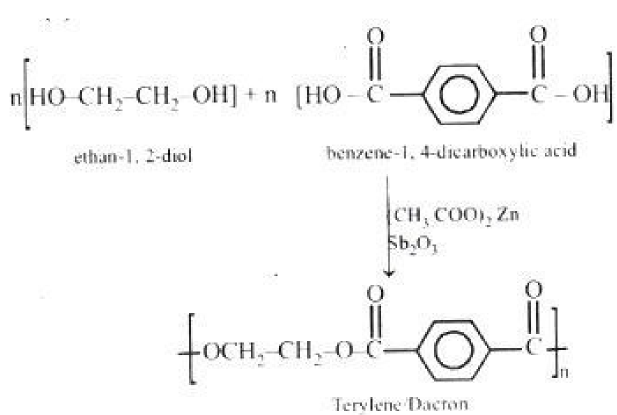
CTH... en e

AD. eligdelnnsity

SonPH g

lsVyu. CtC io n:

T



A90. H. .i..s..t..a..m... iins ea potent vasodilator.

n

A. CSeCodoeetnidei ne
B. rt ioni

DC.
Hoislsu.i mtAio :

S n

Mmseucarstatecmnhtleieosinn oe of ifbs hl aoy opddor otvecenhstlso evrlaiscs o o

m ofa ttics

ith eequation $x^2 + bx - c = 0 (b,c > 0)$ are

C.. obfotthh pnpeogsiatiee
BA Rbooots

o op oofs ttheive vs aigbno ve

Son. Nlsu. Cne n
AD

oWe ktniow:

-ivgen H⇒e rPer,od2u

Pproposiote s tfits grnto ⇒roodtsu actre fo s x +ct b oxf −r oc =t i 0s +(b v,e if c > r0o)ots are of

a, if ro =o −rfovoastmes eis o

A2. . RRaouctt

∴od naonardle 2r ooofotsp poo −f tshict/ee1 esqiguna.t ion $2x^4 + x^3 - 11x^2 + x + 2 = 0$ are

DC.. 1/2itos a

$\frac{1}{2}, 2, \frac{1}{4}, -2$

B $\frac{1}{2}, 2, 3, 4$

$\frac{1}{2}, 2, \frac{3}{4}, -2$

Son. lsu. tAio n:

A

Given equation can be reduced to a quadratic equation.

$\therefore 2x^2 + x - 11 + \frac{1}{x} + \frac{2}{x^2} = 0$

$\Rightarrow 2\left(x^2 + \frac{1}{x^2}\right) + \left(x + \frac{1}{x}\right) - 11 = 0$

Put $x + \frac{1}{x} = y$

$2\left(y^2 - 2\right) + y - 11 = 0$

$\Rightarrow 2y^2 + y - 15 = 0$

$\Rightarrow y = -3$ and $\frac{5}{2}$

$\Rightarrow x + \frac{1}{x} = -3, x + \frac{1}{x} = \frac{5}{2}$

$\Rightarrow x^2 + 3x + 1 = 0, 2x^2 - 5x + 2 = 0$

Only 2nd equation has rational roots as $\mathrm{D} = 9$ and roots are $\frac{1}{2}$ and 2 ts of the equation

x. I+f tpaxn 1+5 q∘ a=n d0 ,t tahne 3n0∘

3 pqa r=e the roo

2 $\frac{6\sqrt{3}+10}{\sqrt{3}}$

A. $\frac{10-6\sqrt{3}}{3}$ C.

AD. B $\frac{10+6\sqrt{3}}{3}$

Sonls

u. tB $\frac{10-6\sqrt{3}}{\sqrt{3}}$

io n:

$\because \quad \tan 15^\circ = \tan(45-30)^\circ = \frac{\sqrt{3}-1}{\sqrt{3}+1}$

$\therefore \quad \tan 15^\circ + \tan 30^\circ = -p$

$\Rightarrow \quad p = \frac{-4}{\sqrt{3}(\sqrt{3}+1)}$

$q = \tan 15^\circ \times \tan 30^\circ$

$= \frac{\sqrt{3}-1}{\sqrt{3}(\sqrt{3}+1)} \Rightarrow q = \frac{\sqrt{3}-1}{\sqrt{3}(\sqrt{3}+1)}$

$\therefore p \cdot q = \frac{-4}{\sqrt{3}(\sqrt{3}+1)} \times \frac{(\sqrt{3}-1)}{\sqrt{3}(\sqrt{3}+1)}$

$\Rightarrow \quad p \cdot q = \frac{-4(\sqrt{3}-1)}{3(\sqrt{3}+1)^2} = \frac{10-6\sqrt{3}}{3}$

$\Rightarrow p \cdot q = \frac{10-6\sqrt{3}}{3}$

$\Rightarrow$ Option (2) is correct.

s represented by th e complex number 1 + i, − 2 + 3i, 5/3i on the argand

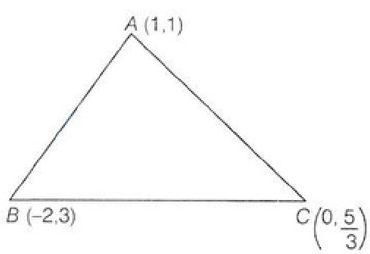
p4/VaEhteaproeint
oeerltiiicaels ooff aann iesqouscilealteesr tarli tarniagnlegle

A

AD. CNnenc eoaf rt he above
C..

Snsolo

Aoclcu. otCridinn:g to question,



Let find slope of AB, BC and CA

Slope of $AB = \frac{1-3}{1-(-2)} = \frac{-2}{3}$

Slope of $BC = \frac{3-\left(\frac{5}{3}\right)}{-2-0} = \frac{-2}{3}$

Slope of $CA = \frac{\frac{5}{3}-1}{0-1} = \frac{-2}{3}$

Since, slope of all lines are same, therefore, points are collinear.

z such that |z + 3 − i| = 1 and arg(z) = π is

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Let $z = x + iy$

Given, $|z + 3 - i| = 1$

$\Rightarrow \quad |(x+3) + (y-1)i| = 1$

$\Rightarrow \quad \sqrt{(x+3)^2 + (y-1)^2} = 1$

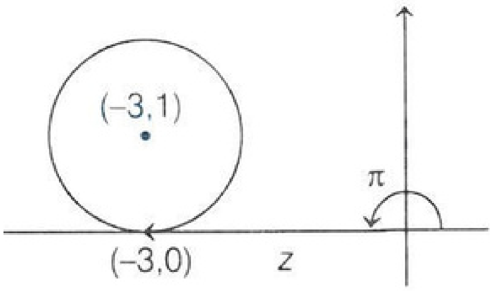
$\Rightarrow \quad (x+3)^2 + (y-1)^2 = 1 \ldots (i)$

Above is the equation of circle with centre $\equiv (-3, 1)$ and

$\text{radius } = 1$

Also, $\arg(z) = \pi \Rightarrow \tan^{-1}\left|\frac{y}{x}\right| = \pi$

$\Rightarrow \quad \left|\frac{y}{x}\right| = \tan\pi = 0 \Rightarrow y = 0$



By Eq. (i),

$\Rightarrow x \quad = -3$

$\therefore z \quad = -3 + 0i$

$\Rightarrow$ **Modulus of** z $= 3$ forms a recta ngle of area 2√3 square units, then one such z is

A.. I1f/2 +√3i $z, \bar{z}, -z, -\bar{z}$

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$\frac{\sqrt{5}+\sqrt{3i}}{4}$

B. $\frac{3}{2} + \frac{\sqrt{3i}}{2}$

C. $\frac{\sqrt{3}+\sqrt{11i}}{2}$

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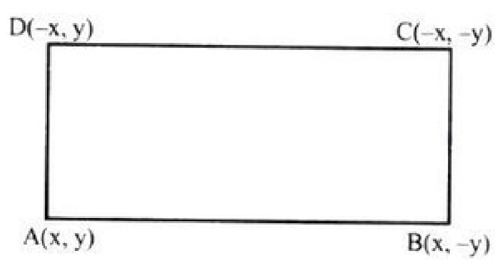
$\Rightarrow \bar{z} = \bar{x} - iy$

Then, vertices of rectangle for $z, \bar{z}, -z, -\bar{z}$ are $(x, y), (x, -y), (-x, -y), (-x, y)$



Now, Area of rectangle $= (2x)(2y) = 4xy$

It is given that,

Area $= 2\sqrt{3} = 4xy \Rightarrow 2xy = \sqrt{3}$

$\therefore x = \frac{1}{2}, y = \sqrt{3} \quad \therefore z = \frac{1}{2} + \sqrt{3}i$

ucl tmoplex num bers such that |z| = |z|= ..... =|z| = 1, then |z +

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$\left|\frac{1}{z_1} + \frac{1}{z_2} + \ldots\ldots + \frac{1}{z_n}\right|$

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$|z_1| = |z_2| = |z_3| = \ldots\ldots\ldots = |z_n| = 1$

$\Rightarrow z_1\bar{z}_1 = z_2\bar{z}_2 = z_3\bar{z}_3 = \ldots\ldots = z_n\bar{z}_n = 1$

$\bar{z}_1 = \frac{1}{z}, \bar{z}_2 = \frac{1}{z_2}, \bar{z}_3 = \frac{1}{z_3}, \ldots\ldots, \bar{z}_n = \frac{1}{z_n}$

Now, $|z_1 + z_2 + z_3 + \ldots\ldots\ldots + z_n|$

$= |\bar{z}_1 + \bar{z}_2 + \ldots\ldots + \bar{z}_n|$

$|\bar{z}_1 + \bar{z}_2 + \bar{z}_3 + \ldots\ldots + \bar{z}_n| = \left|\frac{1}{z_1} + \frac{1}{z_2} + \frac{1}{z_3} + \ldots\ldots + \frac{1}{z_n}\right|$

and |2z1 + 3z2 + 4z3 | = 4, then absolute value of 8z2z3

+8. If |31| 1= + 2 6,e|4,z|2z1|z=2 4 3

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z 28

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Solution:

$$|8z_2z_3+27z_3z_1+64z_1z_2|=|z_1||z_2||z_3|$$

$$\left|\frac{8}{z_1}+\frac{27}{z_2}+\frac{64}{z_3}\right|$$

$$=(2)(3)(4)\left|\frac{8\bar{z}_1}{|z_1|^2}+\frac{27\bar{z}_2}{|z_2|^2}+\frac{64\bar{z}_3}{|z_3|^2}\right|$$

$$=24\left|2\bar{z}_1+3\bar{z}_2+4\bar{z}_3\right|$$

$$=24\left|\overline{2z_1+3z_2+4z_3}\right|$$

$$=24\left|2z_1+3z_2+4z_3\right|=(24)(4)=96$$

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s o=n nos3 can be arranged on round table = (6 − 1) !

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tal ways of arranging the guest

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To!

$$=\frac{10!}{4!6!}\times 3!\times 5!=\frac{10!}{24}$$

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Here we have 4 odd digits $(3, 3, 5, 5)$ and 5 even digits (2, 2, 8, 8, 8).

$\bar{O}\bar{E}\bar{O}\bar{E}\bar{O}\bar{O}\bar{E}\bar{O}$

where, $E \rightarrow$ even place and $O \rightarrow$ odd place

$\Rightarrow$ Number of ways odd digits will be place on even places

$= \frac{4!}{2!2!}$

Number of ways even digits will be place on odd places

$$= \frac{5!}{2!3!}$$

$$\therefore \text{ Total number of ways } = \frac{4!}{2!2!} \times \frac{5!}{2!3!} = 60$$

If ${}^{22}P_{r+1} : {}^{20}P_{r+2} = 11 : 52$, then r is equal to

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$${}^{22}P_{r+1} : {}^{20}P_{r+2} = 11 : 52$$

or $(21-r)(20-r)(19-r) = 52 \times 2 \times 21$

$\Rightarrow (21-r)(20-r)(19-r) = 14 \times 13 \times 12$

$\Rightarrow (21-r)(20-r)(19-r) = (21-7)(20-7)(19-7)$

$\Rightarrow r = 7$

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T dida . a2nd voter votes for at least one candidate then total

$$= {}^{12}C_1 + {}^{12}C_2 + {}^{12}C_3 + {}^{12}C_4$$

$$= 12 + \frac{12\times 11}{2\times 1} + \frac{12\times 11\times 10}{3\times 2\times 1} + \frac{12\times 11\times 10\times 9}{4\times 3\times 2\times 1}$$

$$= 12 + 66 + 220 + 495 = 793$$

ents of all digits of 12345 such that at least 3 digits will

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$$= {}^5C_3\left\{3! - {}^3C_1 2! + {}^3C_2 1! - {}^3C_3 0!\right\}$$

$$+ {}^5C_4\left\{4! - {}^4C_1(3!) + {}^4C_2(2!) - {}^4C_3(1!) + {}^4C_4(0!)\right\}$$

$$+ {}^5C_4\left\{5! - {}^5C_1 4! + {}^5C_7 3! - {}^5C_2 2! + {}^5C_4 1! - {}^5C_5(0!)\right\}$$

$$= 10(2) + 5(9) + (44) = 20 + 45 + 44 = 109$$

Ath4nIf a > 0, b > 0, c > 0 and a, b, c are distinct, then (a + b)(b + c)(c + a) is greater

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DC. 6a(aa c++ bb ++ cc))

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$\Rightarrow \quad \frac{a+b}{2} \geq \sqrt{ab}$....(ii)

applying Eq. (i) in b and c

$\Rightarrow \quad \frac{b+c}{2} \geq \sqrt{bc}$....(iii)

and applying Eq. (i) in c and a

$\Rightarrow \quad \frac{c+a}{2} \geq \sqrt{ca}$....(iv)

By E'qs. (ii), (iii) and (iv)

$$\Rightarrow \quad \frac{(a+b)(b+c)(c+a)}{8} \geq abc$$

$$\Rightarrow \quad (a+b)(b+c)(c+a) \geq 8abc$$

e– 1a $\sum_{k=1}^{n} k(k+1)(k-1) = pn^4 + qn^3 + tn^2 + sn$ where p, q, t and s are constants, then of s is equal to

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C..

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$$\text{Let } S = \sum_{k=1}^{n} k(k+1)(k-1)$$
$$= \sum_{k=1}^{n} k^3 - k$$

We know that

$\sum_{r=1}^{P} r = \frac{P(P+1)}{2}$

and

$\sum_{r=1}^{P} r^3 = \left[\frac{P(P+1)}{2}\right]^2$

$$S = \left[\frac{n(n+1)}{2}\right]^2 - \left[\frac{n(n+1)}{2}\right]$$
$$= \frac{n(n+1)}{2}\left[\frac{n(n+1)}{2} - 1\right]$$
$$= \left(\frac{n^2+n}{2}\right)\left[\frac{n^2+n-2}{2}\right]$$
$$= \frac{n^4}{4} + \frac{n^3}{2} - \frac{n^2}{4} - \frac{n}{2} \ldots (i)$$

Now, by comparing $pn^4 + qn^3 + tn^2 + sn$ with Eq. (i),

$S = -\frac{1}{2}$e

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Als6o),, (gaiiv +en 1, 2fi)r st 3 numbers are in GP

$$\Rightarrow \quad a^2 = (a+12)(a+6)$$
$$\Rightarrow \quad a^2 = a^2 + 18a + 72$$
$$\Rightarrow \quad a = -\frac{72}{18} = -4$$

$\therefore$ 4 numbers are $8, -4, 2, 8$

t1o7. If A = 1 + ra + r2a + r3a + ...∞ and B = 1 + rb + r + ...∞, then a/b is equal

2b 3b

+ r

B.. llooggB(A1−B()1 − A)

A

$\log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$ of these

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$$A = \frac{1}{1-r^a} \Rightarrow 1 - r^a = \frac{1}{A} \Rightarrow r^a = 1 - \frac{1}{A} = \frac{A-1}{A}$$

$$B = \frac{1}{1-r^b} \Rightarrow 1 - r^b = \frac{1}{B} \Rightarrow r^b = 1 - \frac{1}{B} = \frac{B-1}{B}$$

$$\therefore a \log r = \log\left(\frac{A-1}{A}\right)$$

and $b \log r = \log\left(\frac{B-1}{B}\right)$

$$\therefore \frac{a}{b} = \frac{\log\left(\frac{A-1}{A}\right)}{\log\left(\frac{B-1}{B}\right)} = \log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$$

18. The sum of the infinite series

$1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \frac{51}{6^5} + \frac{70}{6^6} + \ldots$ is equal to:

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Solution:

Let $S = 1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \ldots$ .....(i)

$\frac{S}{6} = \frac{1}{6} + \frac{5}{6^2} + \frac{12}{6^3} + \frac{22}{6^4} + \ldots$ ....(ii)

On subtracting (i) from (ii)

$\frac{5}{6}S = 1 + \frac{4}{6} + \frac{7}{6^2} + \frac{10}{6^3} + \frac{13}{6^4} + \cdots$

$\frac{5}{36}S = \frac{1}{6} + \frac{4}{6^2} + \frac{7}{6^3} + \frac{10}{6^4} + \frac{13}{6^5} + \cdots$

on subtraction

$\frac{25}{36}S = 1 + \frac{3}{6} + \frac{3}{6^2} + \frac{3}{6^3} + \ldots = \frac{8}{5}$

$S = \frac{8}{5} \times \frac{36}{25} = \frac{288}{125}$

29. If $\tan^{-1}\left[\frac{1}{1+1.2}\right] + \tan^{-1}\left[\frac{1}{1+2.3}\right] + \ldots + \tan^{-1}\left[\frac{1}{1+n(n+1)}\right] = \tan^{-1}[x]$, then x is equal to

A $\frac{1}{n+1}$

B $\frac{n}{n+1}$

D $\frac{1}{n+2}$

Ans. D

C $\frac{n}{n+2}$

Given $\tan^{-1}\left(\frac{1}{1+1.2}\right)+\tan^{-1}\left(\frac{1}{1+2.3}\right)+\ldots$
$+\tan^{-1}\left(\frac{1}{1+n(n+1)}\right)=\tan^{-1}(x)$

$\Rightarrow \tan^{-1}\left(\frac{2-1}{1+1.2}\right)+\tan^{-1}\left(\frac{3-2}{1+2.3}\right)+\ldots$
$+\tan^{-1}\left(\frac{n+1-n}{1+n(n+1)}\right)=\tan^{-1}(x)$

$\Rightarrow \tan^{-1}(2)-\tan^{-1}(1)+\tan^{-1}(3)-\tan^{-1}(2)+\ldots$
$+\tan^{-1}(\mathrm{n}+1)-\tan^{-1}(\mathrm{n})=\tan^{-1}(x)$

$\Rightarrow \tan^{-1}(\mathrm{n}+1)-\tan^{-1}(1)=\tan^{-1}(x)$

$\left\{\because \tan^{-1}(A)-\tan^{-1}(B)=\tan^{-1}\left(\frac{A-B}{1+A\cdot B}\right)\right\}$

$\Rightarrow \tan^{-1}\left(\frac{n}{n+2}\right)=\tan^{-1}(x)\Rightarrow x=\frac{n}{n+2}$

20. a3nn, tohf etnwo a :d bis =tinct positive real number a and b(a > b) be twice

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$\frac{a+b}{2}=2\sqrt{ab}\Rightarrow a+b=4\sqrt{ab}$

Now, $(a-b)^2=(a+b)^2-4ab=16ab-4ab=12ab$

$\therefore a-b=\sqrt{12ab}=2\sqrt{3}\sqrt{ab}.$

(Taking + ve sign only as $a>b$)

$\therefore \frac{a+b}{a-b}=\frac{4\sqrt{ab}}{2\sqrt{3}\sqrt{ab}}=\frac{2}{\sqrt{3}}$

By componendo and dividendo,

$\frac{2a}{2b}=\frac{2+\sqrt{3}}{2-\sqrt{3}}$ or $\frac{a}{b}=\frac{2+\sqrt{3}}{2-\sqrt{3}}$

Q21. If $y=\tan^{-1}\frac{1}{x^2+x+1}+\tan^{-1}\frac{1}{x^2+3x+3}$

$+\tan^{-1}\frac{1}{x^2+5x+7}+\ldots$.to n terms, then $\frac{dy}{dx}=$

A. $\frac{1}{x^2+n^2}-\frac{1}{x^2+1}$

B. $\frac{1}{(x+n)^2+1}-\frac{1}{x^2+1}$

C. $\frac{1}{x^2+(n+1)^2}-\frac{1}{x^2+1}$

D. None of these

Solution: B

Given, $y=\tan^{-1}\frac{1}{x^2+x+1}$

$+\tan^{-1}\frac{1}{x^2+3x+3}+\tan^{-1}\frac{1}{x^2+5x+7}+\cdots$

to n terms

$=\tan^{-1}\left\{\frac{1}{1+x(x+1)}\right\}+\tan^{-1}\left\{\frac{1}{1+(x+1)(x+2)}\right\}$

$+\tan^{-1}\left\{\frac{1}{1+(x+2)(x+3)}\right\}$

$+\ldots\ldots\ldots+\tan^{-1}\left\{\frac{1}{1+(x+(n-1))(x+n)}\right\}$

$=\tan^{-1}\left\{\frac{(x+1)-x}{1+(x+1)x}\right\}$

$+\tan^{-1}\left\{\frac{(x+2)-(x+1)}{1+(x+2)(x+1)}\right\}$

$+\tan^{-1}\left\{\frac{(x+3)-(x+2)}{1+(x+3)(x+2)}\right\}$

$+\ldots+\tan^{-1}\left(\frac{(x+n)-(x+n-1)}{1+(x+n)(x+n-1)}\right)$

$\therefore y=\left\{\tan^{-1}(x+1)-\tan^{-1}(x)\right\}$

$+\left\{\tan^{-1}(x+2)-\tan^{-1}(x+1)\right\}$

$+\left\{\tan^{-1}(x+3)-\tan^{-1}(x+2)\right\}$

$+\ldots\ldots\ldots+\left\{\tan^{-1}(x+n)-\tan^{-1}[x+(n-1)]\right\}$

So, $y=\tan^{-1}(x+n)-\tan^{-1}(x)$

On differentiating both sides w.r.t. x, we get

$\frac{dy}{dx}=\frac{1}{1+(x+n)^2}-\frac{1}{1+x^2}$

A22.7. Th2e 4c3oefficient of x2 term in the binom ial expansion of

$\left(\frac{1}{3}x^{\frac{1}{2}}+x^{\frac{-1}{4}}\right)^{10}$ is

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$$T_{r+1}={}^{10}C_r\left(\frac{1}{3}x^{\frac{1}{2}}\right)^{10-r}\left(x^{-\frac{1}{4}}\right)^r$$

$$={}^{10}C_r\times\left(\frac{1}{3}\right)^{10-r}x^{\frac{10-r}{2}-\frac{r}{4}}$$

We have to find coefficient of x^2

$$\frac{10-r}{2}-\frac{r}{4}=2\Rightarrow r=4$$

$$\Rightarrow\quad T_{4+1}={}^{10}C_4\left(\frac{1}{3}\right)^6x^2$$

$$\therefore\ \text{Coefficient of } x^2={}^{10}C_4\left(\frac{1}{3}\right)^6$$

$$=\frac{10\times9\times8\times7}{4\times3\times2\times1}\times\frac{1}{3^6}=\frac{70}{243}$$

23. The coefficient of x in the expansion $\frac{e^{7x}+e^{x}}{e^{3x}}$ is

n

of

$\frac{4^{n-1}+(-2)^n}{n!}$

A. $\frac{4^{n-1}+2^n}{n!}$

B. $\frac{4^n+(-2)^n}{n!}$

C. $\frac{4^{n-1}+(-2)^{n-1}}{n!}$

Sonlsu. tCio n:
D.

Given, $\frac{e^{7x}+e^{x}}{e^{3x}} \Rightarrow e^{4x}+e^{-2x}$

Series of $e^a = 1+\frac{a}{1!}+\frac{a^2}{2!}+\frac{a^3}{3!}\ldots$

$$\Rightarrow e^{4x}+e^{-2x} = \left(1+\frac{4x}{1!}+\frac{(4x)^2}{2!}+\frac{(4x)^3}{3!}+\ldots\right) + \left(1+\frac{(-2x)}{1!}+\frac{(-2x)^2}{2!}+\ldots\ldots\right)$$

Here, coefficient of

$$x^2 \equiv \frac{4^2}{2!}+\frac{(-2)^2}{2!}$$
$$x^3 \equiv \frac{4^3}{3!}+\frac{(-2)^3}{3!}$$
$$\vdots$$
$$x^n = \frac{4^n}{n!}+\frac{(-2)^n}{n!}$$

24. The coefficient of the highest power of x in the expansion of

$$\left(x+\sqrt{x^2-1}\right)^8+\left(x-\sqrt{x^2-1}\right)^8$$

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CBA 2
s.16 C2

Solution:

Since $\left(x+\sqrt{x^2-1}\right)^8+\left(x-\sqrt{x^2-1}\right)^8$

$$=2\left\{{}^8C_0x^8+{}^8C_2x^6\left(x^2-1\right)+{}^8C_4x^4\left(x^2-1\right)^2+{}^8C_6x^2\left(x^2-1\right)^3+{}^8C_8x^0\left(x^2-1\right)^4\right\}$$

So coefficient of highest power of x

$$=2\left\{{}^8C_0+{}^8C_2+{}^8C_4+{}^8C_6+{}^8C_8\right\}$$

$$=(1+1)^8+(1-1)^8=2^8=256$$

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Gonivls3u.tDeni,o n: 17th and 18th terms in the expansion (2 + a)50 are equal

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$\therefore T_{17}=T_{18}$

$$\Rightarrow {}^{50}C_{16}(2)^{34}(a)^{16}={}^{50}C_{17}(2)^{33}(a)^{17}$$

$$\Rightarrow a=\frac{{}^{50}C_{16}}{{}^{50}C_{17}}\times 2=1$$

$\therefore$ Now, coefficient of x^{35} in the expansion

$$(1+x)^{-2}=-36$$

$\because$ Coefficient of x^r is $(r+1)$ in $(1-x)^{-2}$

angles of a triangle and tan A/2 = 1/3, tan B/2 = 2/3.

Ah. Lt A,B a is Careqhuatl teo

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Sonls./3 3utA io n:

A 2//9
BC.. 12

$$A + B + C = 180^\circ \text{ (Angle sum property of a triangle)}$$
$$\Rightarrow A + B = 180^\circ - C$$
$$\Rightarrow \frac{A+B}{2} = 90^\circ - \frac{C}{2}$$
$$\Rightarrow \tan\left(\frac{A}{2} + \frac{B}{2}\right) = \tan\left(90^\circ - \frac{C}{2}\right)$$
$$\Rightarrow \frac{\tan A/2 + \tan B/2}{1 - \tan A/2 \tan B/2} = \cot C/2$$
$$\Rightarrow \frac{\frac{1}{3} + \frac{2}{3}}{1 - \frac{1}{3} \times \frac{2}{3}} = \cot C/2 \Rightarrow \frac{1}{1 - \frac{2}{9}} = \cot C/2$$
$$\Rightarrow \frac{9}{7} = \cot C/2 \Rightarrow \tan C/2 = 7/9$$

AsqTuhael stuo m: of all values of x in [0,2π], for which sin x + sin 2x + s

B27e. in 3x + sin 4x = 0

C.. 1821π

AD. 19πππ

Sonlsu. D tio n:

$(\sin x + \sin 4x) + (\sin 2x + \sin 3x) = 0$

$\Rightarrow 2\sin\frac{5x}{2}\cdot\cos\frac{3x}{2} + 2\sin\frac{5x}{2}\cdot\cos\frac{x}{2} = 0$

$\Rightarrow 2\sin\frac{5x}{2}\left\{\cos\frac{3x}{2} + \cos\frac{x}{2}\right\} = 0$

$\Rightarrow 2\sin\frac{5x}{2}\left\{2\cos x\cos\frac{x}{2}\right\} = 0$

$2\sin\frac{5x}{2} = 0 \Rightarrow \frac{5x}{2} = 0, \pi, 2\pi, 3\pi, 4\pi, 5\pi, \ldots$

$\Rightarrow x = 0, \frac{2\pi}{5}, \frac{4\pi}{5}, \frac{6\pi}{5}, \frac{8\pi}{5}, 2\pi$

$\cos\frac{x}{2} = 0 \Rightarrow \frac{x}{2} = \frac{\pi}{2} \Rightarrow x = \pi;$

$\cos x = 0 \Rightarrow x = \frac{\pi}{2}, \frac{3\pi}{2}$

So, sum $= 6\pi + \pi + 2\pi = 9\pi$

tions of equations sin9θ = sin θ in the interval [0,2π] is

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Sonlsu tBio n:

Given, $\sin 9\theta = \sin\theta$

$\Rightarrow \quad \sin 9\theta - \sin\theta = 0$

$\Rightarrow \quad 2\cos\left(\frac{9\theta+\theta}{2}\right)\sin\left(\frac{9\theta-\theta}{2}\right) = 0$

$\left[\because \sin C - \sin D = 2\cos\left(\frac{C+D}{2}\right)\sin\left(\frac{C-D}{2}\right)\right]$

$\Rightarrow \quad 2\cos 5\theta \sin 4\theta = 0$

$\Rightarrow$ Either $\cos 5\theta = 0$ or $\sin 4\theta = 0$, also $\theta \in [0, 2\pi]$

$\Rightarrow \quad 5\theta = (2n+1)\frac{\pi}{2}$

or $\quad 4\theta = n\pi$

$\Rightarrow \quad \theta = (2n+1)\frac{\pi}{10}$ or $\theta = \frac{n\pi}{4}$

$\therefore \quad \theta = \frac{\pi}{10}, \frac{3\pi}{10}, \frac{\pi}{2}, \frac{7\pi}{10}, \frac{9\pi}{10}, \frac{11\pi}{10}, \frac{13\pi}{10}, \frac{3\pi}{2}, \frac{17\pi}{10}, \frac{19\pi}{10}$

or $\quad 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}, \frac{3\pi}{2}, \frac{7\pi}{4}, 2\pi$

$\therefore$ Total number of solutions $= 17$

$\left(\because \frac{\pi}{2} \text{ and } \frac{3\pi}{2} \text{ are common}\right)$

nge of (8 sinθ + 6 cosθ)2 + 2 is

[(-20,,12) ra

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. ((−∞0,∞2])

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$-10 \le 8\sin\theta + 6\cos\theta \le 10$

$\Rightarrow 0 \le (8\sin\theta + 6\cos\theta)^2 \le 100$

$\Rightarrow 2 \le (8\sin\theta + 6\cos\theta)^2 + 2 \le 102$

$x = a\left(\frac{1-t^2}{1+t^2}\right)$ and $y = \frac{2at}{1+t^2}$

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Given $x = a\left(\frac{1-t^2}{1+t^2}\right)$ and $y = \frac{2at}{1+t^2}$

$$\text{Let} \quad t = \tan\theta$$
$$\Rightarrow \quad x = a\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right)$$
$$\text{and} \quad y = \frac{2a\tan\theta}{1+\tan^2\theta}$$
$$\Rightarrow \quad x = a\cos 2\theta \text{ and } y = a\sin 2\theta$$
$$\Rightarrow \cos 2\theta = \frac{x}{a} \text{ and } \sin 2\theta = \frac{y}{a}$$

Squaring both sides, we get

$\cos^2 2\theta = \frac{x^2}{a^2}$ ....(i)

and

$\sin^2 2\theta = \frac{y^2}{a^2}$ ....(ii)

Adding Eqs. (i) and (ii), we get

$$\cos^2 2\theta + \sin^2 2\theta = \frac{x^2}{a^2} + \frac{y^2}{a^2}$$
$$\Rightarrow \quad x^2 + y^2 = a^2$$

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DC. (((−−,,83))

An. (s08. ,C7)

A is the intersection of line AB and AC so equation of line passing

is2iy+hA .t1)

Hxeh+ou, gpi

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ug 3hy t −he 1 o)r =th o0c .e...n.(tir)e (0,0), then

+

⇒− 1λ −= λn e= p ass+e sλ t(h2rxo

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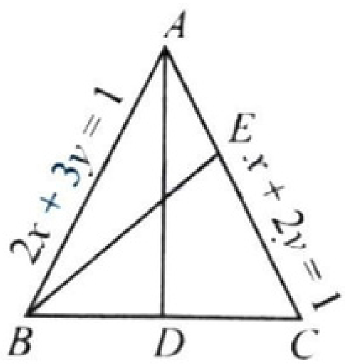
hesreti1ftourteing λ = − 1 in Eq. (i), we get x + y = 0 as the equation of AD. Since AD ⊥



$-1 \times -\frac{a}{b} = -1$. .(pipi)ly ing th

o)ly= b 0y .a

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⇒ .. a + lv

e condition that BE is perpendicular to CA, we get a + 2b =

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As we know that the image of (1,1) with respect to line x + y + 5 = 0 is

$\frac{x-1}{1}=\frac{y-1}{1}=\frac{2(1+1+5)}{1+1}$

$\Rightarrow x-1=-7, y-1=-7$

$\Rightarrow x=-6, y=-6$

$\therefore$ Image of point $(1,1)$ is $(-6,-6)$ Now, distance from origin

This is the required transformed equation.

$D=\sqrt{(0+6)^2+(0+6)^2}$

$D=\sqrt{72}=6\sqrt{2}$

ocoin-tosr dfoinrmatiensg o af tDr.iangle. AD, the

Bi4.e Ac(to3r,2 o,0f)a,n Bg(l5e ,B3,A2C), mC(e−et9s, 6B,C− 3in) Dar. eF itnhdr eteh ep

C.. $\frac{19}{8}, \frac{57}{15}, \frac{57}{15}$

BA $\frac{19}{8}, \frac{57}{16}, \frac{17}{16}$

AD.. ((24,3,0))

,

tB5io n:

Sonlsu.6

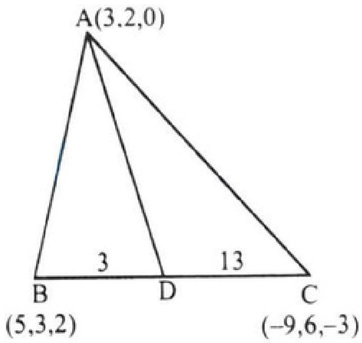
Since AD is the bisector of $\angle BAC$.

$\Rightarrow \frac{BD}{DC}=\frac{AB}{AC}$ ....(i)

Now,

$AB=\sqrt{(5-3)^2+(3-2)^2+(2-0)^2}$

$=\sqrt{4+1+4}=\sqrt{9}=3$



$AC = \sqrt{(-9-3)^2 + (6-2)^2 + (-3-0)^2}$

$= \sqrt{144 + 16 + 9} = 13$

$\therefore \quad \frac{BD}{DC} = \frac{3}{13}$

Hence, D divides BC in the ratio $3 : 13$

The co-ordinates of D are

$\left(\frac{3(-9)+13(5)}{3+13}, \frac{3(6)+13(3)}{3+13}, \frac{3(-3)+13(2)}{3+13}\right)$

$= \left(\frac{19}{8}, \frac{57}{16}, \frac{17}{16}\right)$

lest othf eth oer imgiind -ipsoint of a chord of the circle x + y = 4, which subtends a

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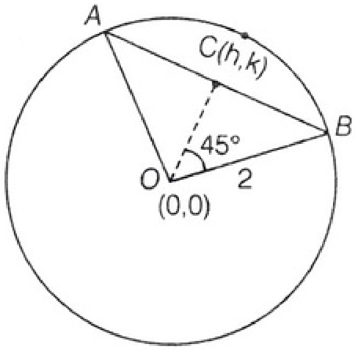

$OC = \sqrt{h^2 + k^2}$

In $\triangle OCB$,

$$\cos 45^\circ = \frac{\sqrt{h^2+k^2}}{2}$$

$$\Rightarrow \quad \frac{\sqrt{h^2+k^2}}{2} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \quad h^2 + k^2 = 2$$

Replacing $h \to x$ and $k \to y$

Locus $\Rightarrow x^2 + y^2 = 2$

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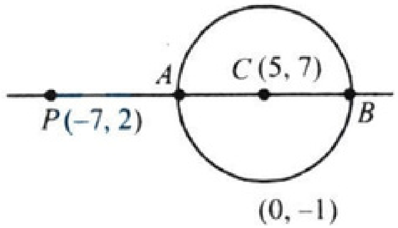
Tohlseu tAcieo nnt:r e C of the circle = (5,7) and the radius
Sn.1

$= \sqrt{5^2 + 7^2 + 51} = 5\sqrt{5}$

$\mathrm{PC} = \sqrt{12^2 + 5^2} = 13 \Rightarrow q = PA = 13 - 5\sqrt{5}$

and $p = PB = 13 + 5\sqrt{3}$



$\therefore$ G.M. of p and q

$$= \sqrt{pq} = \sqrt{(13 - 5\sqrt{5})(13 + 5\sqrt{5})}$$

$$= \sqrt{169 - 125} = 2\sqrt{11}.$$

it Q succh eth AQt) = 22A (By .– T h3e)n= th 4e,Isao ccuhso rodf QABis draw

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c3nh(txF=sr4e)2 apA+ ec(oo(1y)e oi n−t+h3e) c2rl3 =p

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co+o (tryd n i−na o3ft) ces i =of 4 Q is (h,k).

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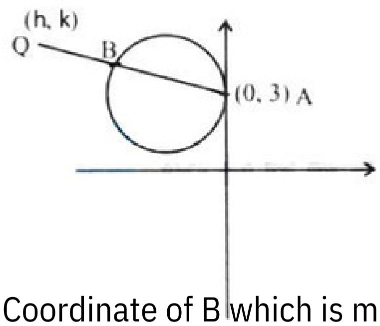

Coordinate of B which is m idpoint of AQ because AQ = 2AB.

Then, $\mathbf{B} = \left(\frac{0+h}{2}, \frac{k+3}{2}\right) \rightarrow \left(\frac{h}{2}, \frac{k+3}{2}\right)$

Point B also satisfy the equation of circle.

$(x+2)^2 + (y-3)^2 = 4$

$\left(\frac{h}{2}+2\right)^2 + \left(\frac{k+3}{2}-3\right)^2 = 4$

$\frac{(h+4)^2}{4} + \frac{(k-3)^2}{4} = 4$

$(h+4)^2 + (k-3)^2 = 16$

Replace (h, k) by (x, y), then, the required equation is $(x+4)^2 + (y-3)^2 = 16$

peanrabola (y – k)2 = 4(x – h) always lies between the lines x + y =

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0o h 1) xi+ yw –i t3h = 0spect to line x + y – 1 =

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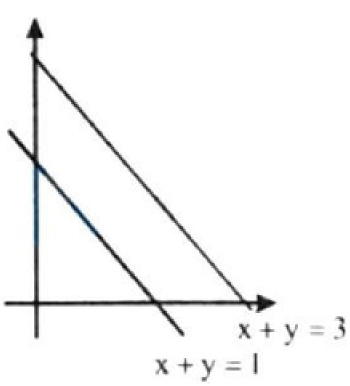

a.Lceet h +k d 2.

B9en 2e1 the le 0tenhgth of t ohe t < lhaet ucso mremctounm c ohfor2d y =of 8 txh,e t hcuenrv:es $x^2 + y^2 = 9$ and $y^2 = 8x$,

An d b L_2

. L_1 =>

C L1

BD. L1 < LL

$\frac{L_1}{L_2} = \sqrt{2}$

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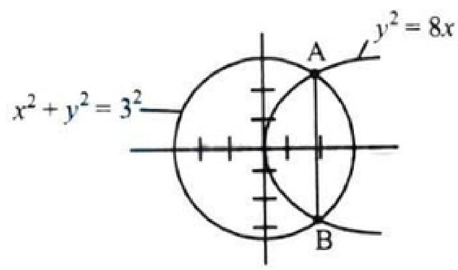

We have : $x^2 + (8x) = 9$

$\Rightarrow x^2 + 9x - x - 9 = 0$

$\Rightarrow x(x+9) - 1(x+9) = 0$

$\Rightarrow (x+9)(x-1) = 0 \quad \Rightarrow x = -9, 1$

for $x = 1, y = \pm 2\sqrt{2x} = \pm 2\sqrt{2}$

$\sqrt{(2\sqrt{2} + 2\sqrt{2})^2 + (1-1)^2} = 4\sqrt{2}$

L_n = Length of latus rectum $= 4a = 4 \times 2 = 8$

$L_1 < L_2$

f hyperbola $4x^2 - 9y^2 - 1 = 0$ are

30. The foci o

A. $\left(\pm \frac{\sqrt{13}}{6}, 0\right)$

.

C. $\left(0, \pm \frac{\sqrt{3}}{6}\right)$

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Given, Hyperbola $= 4x^2 - 9y^2 - 1 = 0$

$$\Rightarrow \frac{x^2}{\left(\frac{1}{4}\right)} - \frac{y^2}{\left(\frac{1}{9}\right)} = 1$$
$$\Rightarrow \frac{x^2}{\frac{1}{2}^2} - \frac{y^2}{\frac{1}{3}^2} = 1$$

We know that. if hyperbola is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$. then Eccentricity:

$$e = \sqrt{1 + \frac{b^2}{a^2}}$$

$$\text{and focus} \equiv (\pm \text{be}, 0) = \left(\pm \frac{1}{2} \times \frac{\sqrt{1/3}}{3}, 0\right) = \left(\pm \frac{\sqrt{13}}{6}, 0\right)$$

41. Given a real valued function ' f ' such that

$$f(x) = \begin{cases} \frac{\tan^2\{x\}}{x^2 - [x]^2} & \text{for } x > 0 \\ 1 & \text{for } x = 0 \\ \sqrt{\{x\}\cot\{x\}} & \text{for } x < 0 \end{cases}$$

B.. LHn L = 1

AThe

$\text{RHL} = \sqrt{\cot 1}$

$\lim_{x \to 0} f$ exist

(x)Dx→0 f(x) d oes not exists

An. lsim.

Soluio n:

$\lim_{x\to 0^-} f(x) = \lim_{h\to 0} \sqrt{\{-h\}\cot\{-h\}}$

$= \lim_{h\to 0} \sqrt{(1-h)\cot(1-h)} = \sqrt{\cot 1}$

$\lim_{x\to 0^+} f(x) = \lim_{h\to 0} \frac{\tan^2\{h\}}{h^2-|h|^2} = \lim_{h\to 0} \frac{\tan^2 h}{h^2} = 1$

$\therefore \lim_{x\to 0} f(x)$ does not exist.

Let $f(x) = \sin x, g(x) = \cos x, h(x) = x^2$ then

$\lim_{x\to 1} \frac{f(g(h(x)))-f(g(h(1)))}{x-1} =$

Q2. A. −0. 2sin 1cos(cos1)

AD. ∞−2
B

Sonlsu. tBsin 1 cos 1
io n:

Given $f(x) = \sin x, g(x) = \cos x, h(x) = x^2$

$\lim_{x\to 1} \frac{f(g(h(x)))-f(g(h(1)))}{x-1}$

When limit it applied, it gives $\frac{0}{0}$ form, so we apply L'Hospital rule.

$\Rightarrow \lim_{x\to 1} \frac{\cos(\cos x^2)(-\sin x^2)(2x)-0}{1-0}$

Apply the limit,

$\Rightarrow -2(1)\sin(1)\cos(\cos 1)$

$= -2\sin(1)\cos(\cos 1)$

Q43. The Boolean expression (p ∨ q) ∨ (p ∧ q) is equivalent to

D. A. p. q q p

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Given, $\sim(p \vee q) \vee (\sim p \wedge q)$

$\Rightarrow (\sim p \wedge \sim q) \vee (\sim p \wedge q)$ (By De Morgan's Law)

$\Rightarrow \sim p \wedge (\sim q \vee q)$ (Distributive Law)

$\Rightarrow \sim p \wedge t$ (By complement law, where $t =$ tautology)

$\Rightarrow \sim p$ (Identity law)

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$$\Rightarrow \frac{2(1+\sin t)\cos t}{2\cos^2 t} = \sqrt{3}$$

$$\Rightarrow t = \frac{\pi}{6}, y_0 = 27$$

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l po)g ∨ic arl) satnadtements. Consider the compound statements

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qq ∨ ∨ r r))) → By conditional law

≡S 2 : pp ∨ (∨→ ((q ∨ r

4S 18 ≡p S2 id

PP1 . o ing two propositions:

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ndn d PP2 i ∨ (F(p) ∨ q) is evaluated as FALSE, then :
q)
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.o thh P P1 andP P2 aree iss FTARLUSEEU
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SonlsutCio n:
AD. B

Given propositions $P_1 :\sim (p \rightarrow \sim q)$

$P_2 : (p \wedge \sim q) \wedge ((\sim p) \vee q)$

Required table is shown below.

p	q	$\sim p$	$\sim q$	$\sim p \vee q$	$p \rightarrow (\sim (p \vee q)$	$p \rightarrow \sim q$	$\sim (p \rightarrow \sim q)$	$p \wedge \sim q$	p_2
T	T	F	F	T	T	F	T	F	F
T	F	F	T	F	F	T	F	T	F
F	T	T	F	T	T	T	F	F	F
F	F	T	T	T	T	T	F	F	F

$p \rightarrow (\sim p \vee q)$ is F when p is true q is false From table P_1 & P_2 both are false

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$$\text{Mean} = \frac{2+3+5+8+12}{5} = 6$$

$$\therefore \sigma^2 = 13.2$$

$$\text{Median} = 5 = m$$

$\therefore$ Mean deviation about median

$$\Rightarrow \frac{\Sigma|x_i - m|}{n} = \frac{3+2+0+3+7}{5} = 3$$

$$M = 3 \Rightarrow \sigma^2 - M = 13.2 - 3 = 10.2$$

80. Thewe m meeaann o ifs n: items is X. If the first item is increased by 1, second by 2 and so on,

$\bar{X} + \frac{x}{2}$

$\bar{X} + x$

$\overline{X} + \frac{n+1}{2}$ e of th ese

D. C. N

Son olsu. ntCio n:

Let the items be $\mathbf{a_1, a_2, \ldots\ldots\ldots, a_n}$

then $\bar{X} = \frac{a_1 + a_2 + \ldots\ldots + a_n}{n}$

Now, according to the given condition:

$\bar{X} = \frac{(a_1+1)+(a_2+2)+\ldots\ldots\ldots+(a_n+n)}{n}$

$= \overline{\mathbf{X}} + \frac{1+2+3+\ldots\ldots\ldots+n}{n} = \bar{X} + \frac{n(n+1)}{2n}$

(using sum of n natural nos.)

$= \overline{\mathbf{X}} + \frac{n+1}{2}$

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axt,, x,..., x0 and $\bar{x}$ be their mean. Given that, variance = 5

n e=

2

Variance $\left(\sigma^2\right) = \frac{1}{n} \sum_{i=1}^{20} \left(x_i - \bar{x}\right)^2$

i.e. $5 = \frac{1}{20} \sum_{i=1}^{20} \left(x_i - \bar{x}\right)^2$

or $\sum_{i=1}^{20} \left(x_i - \bar{x}\right)^2 = 100$ .....(i)

If each observation is multiplied by 2 and the new resulting observations are y_i, then

$y_i = 2x_i$ i.e., $x_i = \frac{1}{2} y_i$

Therefore,

$\bar{y} = \frac{1}{n} \sum_{i=1}^{20} y_i = \frac{1}{20} \sum_{i=1}^{20} 2x_i = 2 \cdot \frac{1}{20} \sum_{i=1}^{20} x_i$

i.e., $\bar{y} = 2\bar{x}$ or $\bar{x} = \frac{1}{2}\bar{y}$.

On substituting the values of x_i and $\bar{x}$ in eq. (i), we get

$\sum_{i=1}^{20} \left(\frac{1}{2} y_i - \frac{1}{2}\bar{y}\right)^2 = 100$

i.e., $\sum_{i=1}^{20} \left(y_i - \bar{y}\right)^2 = 400$

Thus, the variance of new observations

$= \frac{1}{20} \times 400 = 20 = 2^2 \times 5$.

52. If the function f(x), defined below, is continuous on the in terval [0,8], then

$$f(x) = \begin{cases} x^2 + ax + b & , 0 \le x < 2 \\ 3x + 2, & 2 \le x \le 4 \\ 2ax + 5b, & 4 < x \le 8 \end{cases}$$

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At x = 2,

$$\lim_{x\to 2^-} f(x) = \lim_{x\to 2^+} f(x)$$

$$\lim_{x\to 2^-} \left(x^2 + \mathrm{ax} + \mathrm{b}\right) = \lim_{x\to 2^+} (3x+2)$$

$$4 + 2a + b = 3(2) + 2$$

$\therefore 2a + b = 4$ ...(i)

At $x = 4$

$$\lim_{x\to 4^-} f(x) = \lim_{x\to 4^+} f(x)$$

$$\lim_{x\to 4^-} (3x+2) = \lim_{x\to 4^+} 2ax + 5b$$

$$3(4) + 2 = 2a(4) + 5b$$

$\therefore 8a + 5b = 14$ ....(ii)

On solving Eqs. (i) and (ii), we get

$a = 3$ and $b = -2$.

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√3 m – 1)m

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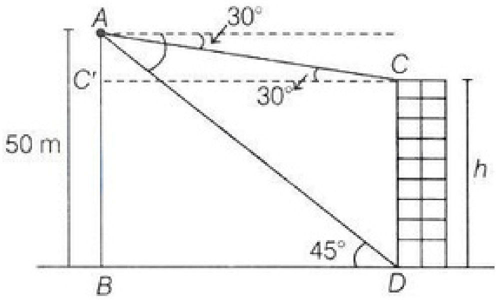
$$50\left(1 - \frac{\sqrt{3}}{3}\right)\mathrm{m}$$

Aoclscuotdio inng: to condition,

Sn. D



Let, height of tower = h

In $\triangle ABD$, $\tan 45^\circ = \frac{AB}{BD} \Rightarrow BD = 50\ \text{m}$

Now, In $\triangle ACC'$

$$\tan 30^\circ = \frac{AC'}{C'C}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{50-h}{50}$$

$$\Rightarrow \quad 50 = 50\sqrt{3} - h\sqrt{3}$$

$$\Rightarrow \quad h\sqrt{3} = 50(\sqrt{3}-1)$$

$$h = 50\left(1 - \frac{1}{\sqrt{3}}\right)$$

$$= 50\left(1 - \frac{\sqrt{3}}{3}\right)\ \text{m}$$

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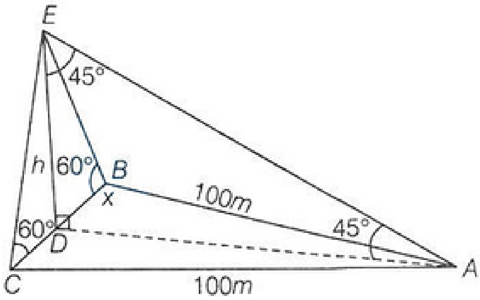

Let $DE = h$ and $CD = DB = x$

In $\triangle EBD$, $\tan 60^\circ = \frac{h}{x} \Rightarrow x = \frac{h}{\sqrt{3}}$

Now, in $\triangle ADE$

$$\tan 45^\circ = \frac{ED}{DA}$$
$$\Rightarrow \quad DA = h$$

In $\triangle ABD$, by applying Pythagoras theorem

$$\Rightarrow \quad \left(\frac{h}{\sqrt{3}}\right)^2 + h^2 = 100^2$$
$$\Rightarrow \quad \frac{4h^2}{3} = 10000 \quad \Rightarrow h = 50\sqrt{3}$$

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$$
\begin{aligned}
\text{Given, } n(R) &= 794\\
n(T) &= 187\\
n(R \cup T)' &= 63\\
n(\text{Total}) &= n(R \cup T) + n(R \cup T)'\\
\Rightarrow \quad 1003 &= n(R \cup T) + 63\\
\Rightarrow \quad n(R \cup T) &= 940
\end{aligned}
$$

By set theory

$$
\begin{aligned}
\Rightarrow \quad n(R \cup T) &= n(R) + n(T) - n(R \cap T)\\
\Rightarrow \quad 940 &= 794 + 187 - n(R \cap T)\\
\Rightarrow \quad n(R \cap T) &= 981 - 940 = 41
\end{aligned}
$$

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S denote the set of all triangles in a plane.

Let R be the relation on S defined by $(\Delta_1, \Delta_2) \in R$

$\Rightarrow$ triangle $\Delta_1 \cong \Delta_2$:

(i) Let any triangle $\Delta \in S$, we have

$\Delta_1 \cong \Delta_2 \Rightarrow (\Delta, \Delta) \in R \forall \Delta \in S \Rightarrow R$ is reflexive on

(ii) Let $\Delta_1, \Delta_2 \in$ S, such that $(\Delta_1, \Delta_2) \in R$, then $\Delta_1 \cong \Delta_2 \Rightarrow \Delta_2 \cong \Delta_1 \Rightarrow (\Delta_2, \Delta_1) \in R \Rightarrow R$ is symmÄ™tric

(iii) Again, let $\Delta_1, \Delta_2, \Delta_3 \in$ S such that $(\Delta_1, \Delta_2) \in R$ and

$(\Delta_2, \Delta_3) \in R \therefore \Delta_1 \cong \Delta_2 \cong \Delta_3$

$\therefore (\Delta_1, \Delta_2) \in R$

$\Rightarrow R$ is transitive.

$\therefore$ R is an equivalence relation.

B. 5 6

A57. Number of subsets of set of letter of word 'MONOTONE'.

628

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f w5 or 3d2 'MONO- TONE' is {M,N,O,T,E}

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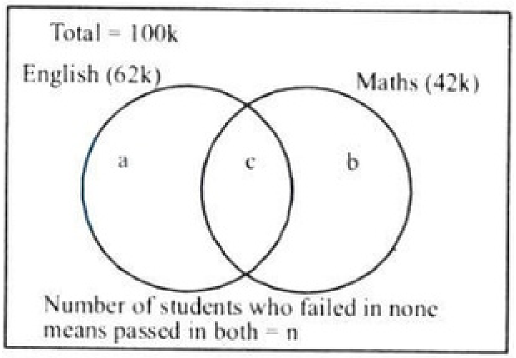
n8.o 2n0 ab utercdtofniheonilbexaf,boui2tn%abfcs2pehrf toh=f et hcoasned iwdhatoe ps afasisleedd iinn bEon

C. 1161

BAa. d

ADn. 1N8s.o Bne of these

Solution:



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Haenrc ebehvte,eoitio wh 2 o2 fakd20ked in none means passed in both = n = 100k − (a + b +

N ar k n =

=c 100k − (42k + 22k + 20k) = 16k. or 16%

If $A = \frac{1}{3}\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$ is an orthogonal matrix, then

A58. , b1= −1

aa == −22,,

CD. as== − 2bb =

, =b =− 11

Welu.A ktnio onw: that, if A is an orthogonal matrix, then

Son

$$\Rightarrow \quad AA^T = I$$

$$\Rightarrow$$

$$\Rightarrow \quad \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix} \cdot \frac{1}{3} \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & 2 \\ 2 & -2 & b \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix} \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & 2 \\ 2 & -2 & b \end{bmatrix} = \begin{bmatrix} 9 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & 9 \end{bmatrix}$$

$$\begin{bmatrix} 9 & 0 & a+4+2b \\ 0+4+2b & 9 & 2a+2-2b \\ 2a+2-2b & a^2+4+b^2 & \end{bmatrix}$$

$$= \begin{bmatrix} 9 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & 9 \end{bmatrix}$$

$$\Rightarrow \quad a+4+2b = 0 \text{ and } 2a+2-2b = 0$$

$$a + 2b = -4 \ldots (i)$$

$$a - b = -1 \ldots (ii)$$

By solving Eqs. (i) and (ii), we get

$a = -2, b = -1$

If matrix $A = \begin{bmatrix} 3 & -2 & 4 \\ 1 & 2 & -1 \\ 0 & 1 & 1 \end{bmatrix}$ and $A^{-1} = \frac{1}{k}\text{adj}(A)$, then k is

CB. -7 7
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Given, $A = \begin{bmatrix} 3 & -2 & 4 \\ 1 & 2 & -1 \\ 0 & 1 & 1 \end{bmatrix}$

and

$A^{-1} = \frac{1}{k}\mathbf{adj}(A)$....(i)

We know that, $A^{-1} = \frac{\mathrm{adj}(A)}{|A|}$...(ii)

By comparing Eqs. (i) and (iii),

$k = |A|$

So,

$$|A| = \begin{vmatrix} 3 & -2 & 4 \\ 1 & 2 & -1 \\ 0 & 1 & 1 \end{vmatrix}$$

$= 3(2+1) + 2(1+0) + 4(1-0) = 15$

.= AY, athnedn B(XrYe) Ts y=mmetric matr ices of same order such th

ABA. If a at AB + BA = X and AB –

61 XY ⊤

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XX⊤Y

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–Y.Y ⊤X⊤

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Since $XY = (AB + BA)(AB - BA)$

$= (\mathrm{AB})\mathrm{AB} + (\mathrm{BA})(\mathrm{AB}) - (\mathrm{AB})(\mathrm{BA}) - (\mathrm{BA})(\mathrm{BA})$

Now $(XY)^{\mathrm{T}} = ((\mathrm{AB}) \cdot (\mathrm{AB}))^{\mathrm{T}} + (\mathrm{BA} \cdot \mathrm{AB})^{\mathrm{T}} - (\mathrm{AB} \cdot \mathrm{BA})^{\mathrm{T}}$

$= (\mathrm{AB})^{\mathrm{T}} \cdot (\mathrm{AB})^{\mathrm{T}} + (\mathrm{AB})^{\mathrm{T}} \cdot (\mathrm{BA})^{\mathrm{T}} - (\mathrm{BA})^{\mathrm{T}}(\mathrm{AB})^{\mathrm{T}} - (\mathrm{BA})^{\mathrm{T}}(\mathrm{BA})^{\mathrm{T}}$

$= (B^{\top} \cdot A^{\top})(B^{\top} \cdot A^{\top}) + (B^{\top} \cdot A^{\top}) \cdot (A^{\top} B^{\top})$

$- (\mathrm{A}^{\top}\mathrm{B}^{\top})(\mathrm{B}^{\top}\mathrm{A}^{\top}) - (\mathrm{A}^{\top}\mathrm{B}^{\top})(\mathrm{A}^{\top}\mathrm{B}^{\top})$

Since, A & B are symmetric matrix.

$= (\mathrm{BA})(\mathrm{BA}) + (\mathrm{BA})(\mathrm{AB}) - (\mathrm{AB})(\mathrm{BA})$

$-(\mathrm{AB})(\mathrm{AB})$

$= (\mathrm{BA} - \mathrm{AB})(\mathrm{BA} + \mathrm{AB}) = -\mathrm{YX}$

62. If $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$, $P = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ and $X = APA^T$, then $A^T X^{50} A =$

A. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 2 & 1 \\ 0 & -1 \end{bmatrix}$

C. $\begin{bmatrix} 25 & 1 \\ 1 & -25 \end{bmatrix}$

D. $\begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix}$

Answer: D

Solution:

Since $AA^T = I$ therefore matrix A is orthogonal matrix.

Now, $A^T X^{50} A = A^T X^{49} \left(APA^T\right) A$

$= A^T X^{49} AP \left(A^T A\right) = A^T X^{49} AP$

$= A^T X^{48} \left(APA^T\right) AP = A^T X^{48} AP^2 \ldots\ldots.$

$= A^T AP^{50} = IP^{50} = P^{50}$

$\because \quad P = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \Rightarrow P^2 = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$

$\Rightarrow P^3 = \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} \ldots\ldots$

$\Rightarrow \quad P^{50} = \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix}$

So, $A^T X^{50} A = P^{50} = \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix}$

A63 AIf A is a square matrix of order 3 , th en l Adj(Adj A2) l =

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B. A||2

AD ||A|8

C.. lsu. |C1 6

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So

$|\text{adj}\left(\text{adj } A^2\right)| =$

$|\text{ adj A}| = |\text{A}|^{n-1} = |\text{A}|^2$

$|\text{adj } A^2| = |\text{ adj } A|^2 = \left(|A|^2\right)^2 = |A|^4$

$|\text{adj}\left(\text{adj } A^2\right)| = \left(|A|^4\right)^{3-1}$

$= \left(|A|^4\right)^2 = |A|^8$

ap .+ Su)xp + o+s eb= 0 ystem of equation

64 p yyp ,c+rq≠0 and s

axx +(aqy + b(r) + + c=)zz 00, has a non-trivial solution, then the value of $\frac{a}{p}+\frac{b}{q}+\frac{c}{r}$ is

B. -+ 1b

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A

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Son lsu.tAio n:

Let $|A| = \begin{vmatrix} p+a & b & c \\ a & q+b & c \\ a & b & r+c \end{vmatrix}$

Also, given that equations has non trivial solution

$|A| = 0$

$$\Rightarrow \begin{vmatrix} p+a & b & c \\ a & q+b & c \\ a & b & r+c \end{vmatrix} = 0$$

$$\Rightarrow (p+a)[(q+b)(r+c)-bc]-b[a(r+c)-ca] + c[ab-a(q+b)] = 0$$

$$\Rightarrow (p+a)[qr+qc+br]-b[ar]+c[-aq]=0$$

$$\Rightarrow pqr+pqc+pbr+aqr=0$$

Dividing whole equation by pqr

$$\Rightarrow \frac{pqr}{pqr}+\frac{pqc}{pqr}+\frac{prb}{pqr}+\frac{qra}{pqr}=0$$

$$\Rightarrow 1+\frac{c}{r}+\frac{b}{q}+\frac{a}{p}=0$$

$$\Rightarrow \frac{a}{p}+\frac{b}{q}+\frac{c}{r}=-1$$

65. If x is a complex root of the equatio n

$$\begin{vmatrix} 1 & x & x \\ x & 1 & x \\ x & x & 1 \end{vmatrix} + \begin{vmatrix} 1-x & 1 & 1 \\ 1 & 1-x & 1 \\ 1 & 1 & 1-x \end{vmatrix} = 0,$$

then $x^{2007} + x^{-2007} =$

CB.. −−1 21

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Eon 2lsxpuatnio dnin: g the two determinants, we get

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$$\left(1-3x^2+2x^3\right)+\left(3x^2-x^3\right)=0$$

$$\Rightarrow x^3+1=0$$

$$\Rightarrow x=-\omega,-\omega^2,-1$$

$$x^{2007}+x^{-2007}=-1-1=-2$$

4u = o6ns x − y + 2z = 4

8x + y + z
36. The equati
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Given equations, $x - y + 2z = 4$

$3x + y + 4z = 6$

$x + y + z = 1$

Let $\Delta = \begin{vmatrix} 1 & -1 & 2 \\ 3 & 1 & 4 \\ 1 & 1 & 1 \end{vmatrix}$

$= 1(1-4) + 1(3-4) + 2(3-1)$

$= -3 - 1 + 4 = 0$

and $\Delta_1 = \begin{vmatrix} 4 & -1 & 2 \\ 6 & 1 & 4 \\ 1 & 1 & 1 \end{vmatrix}$

$= 4(1-4) + 1(6-4) + 2(6-1)$

$= -12 + 2 + 10 = 0$

Now, $\Delta = 0$ and $\Delta_1 = 0$

67 T o nmsa2n xy +so ylu –t izo =ns 7.

A. heBtfey2Sysk6Ezo tf = laRe 1anxsfiin i4nfiyn a+te lδyzq m ui=aetliy a kn y solutions, then δ + k is equal to:

x

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eFqorlu agteiittnoninsg infinite solutions D = 0, D1 = D2 = D = 0 then check all the three

Let $\Delta = \begin{vmatrix} 2 & 1 & -1 \\ 1 & -3 & 2 \\ 1 & 4 & \delta \end{vmatrix} = 0 \quad \Rightarrow \delta = -3$

And $\Delta_1 = \begin{vmatrix} 7 & 1 & -1 \\ 1 & -3 & 2 \\ k & 4 & -3 \end{vmatrix} = 0 \Rightarrow k = 6$

$\Rightarrow \delta + k = 3$

If $\cot\left(\cos^{-1} x\right) = \sec\left\{\tan^{-1}\left(\frac{a}{\sqrt{b^2-a^2}}\right)\right\}$

$b > a$, then $\mathrm{x} =$

68 $\frac{b}{\sqrt{2b^2-a^2}}$

A. $\frac{\sqrt{b^2-a^2}}{ab}$

C.. $\frac{a}{\sqrt{2b^2-a^2}}$
B

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$\frac{\sqrt{b^2-a^2}}{a}$

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$$\cot\left(\cos^{-1}x\right)=\sec\left\{\tan^{-1}\left(\frac{a}{\sqrt{b^2-a^2}}\right)\right\}$$

Since, $\cos^{-1}x=\cot^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)$ and $\tan^{-1}x=\sec^{-1}\left(\sqrt{1+x^2}\right)$

$$\Rightarrow \cot\left(\cot^{-1}\frac{x}{\sqrt{1-x^2}}\right)=$$

$$\sec\left\{\sec^{-1}\sqrt{1+\left(\frac{a}{\sqrt{b^2-a^2}}\right)^2}\right\}$$

$$\Rightarrow \frac{x}{\sqrt{1-x^2}}=\sqrt{\frac{b^2-a^2+a^2}{b^2-a^2}}$$

$$\Rightarrow \frac{x}{\sqrt{1-x^2}}=\frac{b}{\sqrt{b^2-a^2}}$$

On squaring both the sides, we get

$$\Rightarrow \frac{x^2}{1-x^2}=\frac{b^2}{b^2-a^2}$$

$$\Rightarrow x^2b^2-x^2a^2=b^2-b^2x^2$$
$$x^2b^2+b^2x^2-x^2a^2=b^2$$

$$\Rightarrow \quad 2x^2b^2-x^2a^2=b^2\Rightarrow x^2\left(2b^2-a^2\right)=b^2$$

$$\Rightarrow \quad x=\frac{b}{\sqrt{2b^2-a^2}}$$

(1 /2) = cot(cos

1√ cos cot x), then the value of x is

−1 −1

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$\cos\left(\cot^{-1}\left(\frac{1}{2}\right)\right) = \cot\left(\cos^{-1} x\right)$

Let $\cot^{-1}\left(\frac{1}{2}\right) = \alpha \Rightarrow \cot\alpha = \frac{1}{2} \Rightarrow \cos^{-1}\frac{1}{\sqrt{5}}$

$\Rightarrow \cos\left(\cos^{-1}\frac{1}{\sqrt{5}}\right) = \cot\left(\cot^{-1}\frac{x}{\sqrt{1-x^2}}\right)$

$\Rightarrow \frac{1}{\sqrt{5}} = \frac{x}{\sqrt{1-x^2}} \Rightarrow \sqrt{1-x^2} = \sqrt{5}x$

On squaring both sides, we get,

$1 - x^2 = 5x^2 \Rightarrow 1 = 6x^2$

$\Rightarrow x = \pm\frac{1}{\sqrt{6}}$

$x = \frac{1}{\sqrt{6}}$ [neglecting - ve sign]

Aof0 Let [x] denote the g isreatest inte ger ≤ x. If f(x) = [x] and g(x) = |x|, then the value

$f\left(g\left(\frac{8}{5}\right)\right) - g\left(f\left(-\frac{8}{5}\right)\right)$

7 . 2

AD.: 1

CB.: -2

Son -1 lsu. tDio n:

Given, $f(x)=[x]$ and $g(x)=|x|$

Now,

$$f\left(\frac{-8}{5}\right)=\left[-\frac{8}{5}\right]=-2\ldots(i)$$
$$g\left(\frac{8}{5}\right)=\left|\frac{8}{5}\right|=\frac{8}{5}\ldots(ii)$$

Now, $f\left(g\left(\frac{8}{5}\right)\right)-g\left(f\left(-\frac{8}{5}\right)\right)=f\left(\frac{8}{5}\right)-g(-2)$

By Eqs. (i) and (ii),

$$=\left[\frac{8}{5}\right]-|-2|$$
$$=1-2$$
$$=-1$$

A71 Number of real solution of $\sqrt{5-\log_2|x|}=3-\log_2|x|$ is equal to

CB... 21. AD. 3 4

Son lsu.tBio n:

$$\text{Let} \quad \log_2|x|=t\ldots(i)$$
$$\therefore \quad \sqrt{5-t}=3-t$$
$$\Rightarrow \quad 5-t=(3-t)^2$$
$$\Rightarrow \quad 5-t=9+t^2-6t$$

$$\Rightarrow \quad t^2-5t+4=0$$
$$\Rightarrow \quad (t-4)(t-1)=0$$
$$\Rightarrow \quad t=1 \text{ or } 4[\text{rejected}]$$
$$[\because \sqrt{5-4}=3-4, 1\neq -1]$$
$$\Rightarrow \quad \log_2|x|=1$$
$$\Rightarrow \quad |x|=2$$
$$\Rightarrow \quad x=\pm 2$$

$\therefore$ Total 2 real solutions.

$f(x) = \frac{\cos x}{\left[\frac{2x}{\pi}\right]+\frac{1}{2}}$, x is not an integral multiple of π and [.] denotes the greatest

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$$f(-x) = \frac{\cos(-x)}{\left[-\frac{2x}{\pi}\right]+\frac{1}{2}} = \frac{\cos x}{-1-\left[\frac{2x}{\pi}\right]+\frac{1}{2}}$$

(As x is not an integral multiple of π)

$$= -\frac{\cos x}{\left[\frac{2x}{\pi}\right]+\frac{1}{2}} = -f(x)$$

Therefore, $f(x)$ is an odd function.

$f : \mathbf{R} \to \mathbf{R}$ defined by $f(x) = \frac{x}{\sqrt{1+x^2}}$ is

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Given that, $f(x)=\frac{x}{\sqrt{1+x^2}}$

For injective: Let $x_1, x_2 \in \boldsymbol{R}$ such that $f\left(x_1\right)=f\left(x_2\right)$

$$\Rightarrow \frac{x_1}{\sqrt{1+x_1^2}}=\frac{x_2}{\sqrt{1+x_2^2}} \Rightarrow \frac{x_1^2}{1+x_1^2}=\frac{x_2^2}{1+x_2^2}$$

$$\Rightarrow x_1^2+x_1^2 x_2^2=x_2^2+x_1^2 x_2^2 \Rightarrow x_1^2=x_2^2$$

$$\Rightarrow x_1=x_2$$

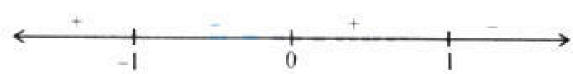
So, $f(x)$ is injective.

For surjective: Let $y=\frac{x}{\sqrt{1+x^2}}$

$$\Rightarrow y^2\left(1+x^2\right)=x^2 \Rightarrow y^2+y^2 x^2=x^2$$

$$\Rightarrow x^2\left(1-y^2\right)=y^2 \Rightarrow x=\sqrt{\frac{y^2}{1-y^2}}$$

$$\Rightarrow \frac{y^2}{1-y^2} \geq 0$$



76.14a f∈) 1, iRs n→o Rt s, ug r:j eRc →tiv Re. are defined by f(x) = 5x − 3,g(x) = x2 + 3, then go
∴ y (
(3) is

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f^{-1}

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D

Given, $f(x) = 5x - 3$ and $g(x) = x^2 + 3$

Let, $y = f(x), \therefore y = 5x - 3$

$y + 3 = 5x \Rightarrow x = \frac{y+3}{5}$

$\therefore \quad f^{-1}(y) = \frac{y+3}{5} \Rightarrow f^{-1}(x) = \frac{x+3}{5}$

Now, $g(x) = x^2 + 3$

So, $g \circ f^{-1}(3) = g\left[f^{-1}(3)\right]$

$= g\left(\frac{3+3}{5}\right) = g\left(\frac{6}{5}\right) = \frac{(6)^2}{(5)^2} + 3 = \frac{36}{25} + 3 = \frac{111}{25}$

75. The domain of the real valued fu nction

BA

$f(x) = \sqrt{\frac{2x^2-7x+5}{3x^2-5x-2}}$ is

$\left(-\infty, -\frac{1}{3}\right) \cup [1, 2) \cup \left[\frac{5}{2}, \infty\right)$

$(-\infty, 1) \cup (2, \infty)$

C...

$\left(-\frac{1}{3}, \frac{5}{2}\right]$

$\left(-\infty, \frac{-1}{3}\right] \cup \left[\frac{5}{2}, \infty\right)$

Sonlsu. tAio n:

AD.

Given function $f(x)=\sqrt{\frac{2x^2-7x+5}{3x^2-5x-2}}$

Here, $\mathbf{f(x)}$ should be greater than or equal to 0 .

So, $2x^2-7x+5=0$

$\Rightarrow \quad 2x^2-5x-2x+5=0$

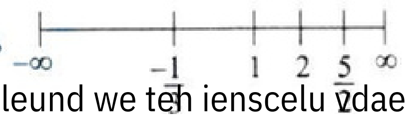
$\Rightarrow \quad (x-1)(2x-5)=0$

$\Rightarrow \quad x=1,\frac{5}{2}$

$3x^2-5x-2=0 \Rightarrow 3x^2-6x+x-2=0$

$3x(x-2)+1(x-2)=0 \Rightarrow (x-2)(3x+1)=0$

$\Rightarrow \quad x=2,\frac{-1}{3}$

Now, 

exhcleund we teh ienscelu vdaelu xe s= f r−o1m/ 3th, 2e dth oemna fi(nx.) would give not define

W

When we take values between $\left(-\frac{1}{3},1\right)$ and

So, domain is $\left(-\infty,\frac{-1}{3}\right)\cup[1,2)\cup\left[\frac{5}{2},\infty\right)$ {l} → R − {m} defined by (x) = x+3/x−2 is a bijection,

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Sonlsu.4 tCio n:

$f(x)=\frac{x+3}{x-2}$

$\because \quad f(x)$ is not defined for $x=2$

i.e. domain of $f(x)$ is $\mathrm{R}-\{2\}$

$\therefore l=2$

Now, $y=\frac{x+3}{x-2}$

$xy-2y=x+3$

$x(y-1)=2y+3$

$x=\frac{2y+3}{y-1}$

y can take any value except $y=1$

Co-domain $=\mathrm{R}-\{1\}$

$m=1$

$3l+2m=3(2)+2(1)=8$

A77. : $f(x) = \sin x + \cos x, g(x) = x2 - 1$, then $g(f(x))$ is invertible if

$\frac{-\pi}{4} \leq x \leq \frac{\pi}{4}$

$\frac{-\pi}{2} \leq x \leq 0$

B.. $\frac{-\pi}{2} \leq x \leq \pi$

AD. $0 \leq x \leq \frac{\pi}{2}$

io n:

Sonlsu. tA

Given that, $f(x) = \sin x + \cos x$

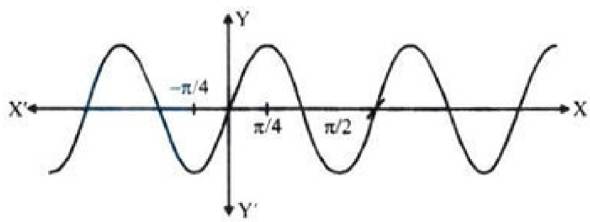
$g(x) = x^2 - 1$

$g[f(x)] = (\sin x + \cos x)^2 - 1$

$= \sin^2 x + \cos^2 x + 2 \sin x \cos x - 1$

$= 1 + \sin 2x - 1 = \sin 2x$

$(\because \sin^2 x + \cos^2 x = 1, \sin x = 2 \sin x \cos x)$



Among the given options, $\sin 2x$ is monotonous

(here strictly increasing) in $-\frac{\pi}{4} \le x \le \frac{\pi}{4}$.

So, $g(f(x))$ is invertible in $-\frac{\pi}{4} \le x \le \frac{\pi}{4}$

T78h. Lete function g : (−∞, ∞) → (− π/2, π/2) be given by g(u) = 2 tan

$^{-1}$ (eu) − π/2.

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Given that $g(u) = 2\tan^{-1}(e^u) - \frac{\pi}{2}$

$\therefore \quad g(-u) = 2\tan^{-1}(e^{-u}) - \frac{\pi}{2} =$

$2\tan^{-1}\left(\frac{1}{e^u}\right) - \frac{\pi}{2}$

$= 2\cot^{-1}(e^u) - \frac{\pi}{2} = 2\left[\frac{\pi}{2} - \tan^{-1}(e^u)\right] - \frac{\pi}{2}$

$= \pi - 2\tan^{-1}(e^u) - \frac{\pi}{2}$

$= \frac{\pi}{2} - 2\tan^{-1}(e^u) = -g(u)$

$\therefore \quad g$ is an odd function.

Also $g'(u) = \frac{2e^u}{1+e^{2u}} > 0, \forall u \in (-\infty, \infty)$

$\therefore g$ is strictly increasing on $(-\infty, \infty)$.

79. Let *f* be the function defined by

$$f(x) = \begin{cases} \frac{x^2-1}{x^2-2|x-1|-1}, & x \neq 1 \\ \frac{1}{2}, & x = 1 \end{cases}$$

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$$f(x)=\begin{cases}\frac{x^2-1}{x^2-2x+1}; & x>1\\ \frac{1}{2} \quad ; & x=1\\ \frac{x^2-1}{x^2+2x-3}; & x<1\end{cases}$$

$\because \quad x^2+3x-x-3$

$=x(x+3)-1(x+3)$

Lets Find

LHL, $\lim_{x\to1^-}\frac{x^2-1}{x^2-2x+1}$ and RHL, $\lim_{x\to1^+}\frac{x^2-1}{x^2+2x-3}$

$$\Rightarrow \lim_{x\to1^-}\frac{(x-1)(x+1)}{(x-1)^2} \Rightarrow \lim_{x\to1^+}\frac{(x-1)(x+1)}{(x+3)(x-1)}$$

$$\Rightarrow \lim_{x\to1^-}\frac{x+1}{x-1}=\infty \Rightarrow \lim_{x\to1^+}\frac{x+1}{x+3}=\frac{2}{4}=\frac{1}{2}$$

$\therefore$ LHL $\neq f(1) \Rightarrow f(x)$ is not continuous at $x=1$

If $f(x)=\begin{cases}\frac{x^2\log(\cos x)}{\log(1+x)}, & x\neq0\\ 0, & x=0\end{cases}$, then at $x=0$, $f(x)$ is

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ot differentiable

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$\lim_{x\to0} f(x) = \lim_{x\to0} \frac{x^2 \log(\cos x)}{\log(1+x)}$

$= \lim_{x\to0} - \frac{x\cdot\log(\cos x)}{\frac{\log(1+x)}{x}}$

$= \lim_{x\to0} x \cdot \log(\cos x) = 0 \cdot \log 1 = 0$

$\because \lim_{x\to0} f(x) = f(0)$

$\therefore f(x)$ is continuous at $x = 0$

Now, $\lim_{x\to0} \frac{f(x+h)-f(x)}{h}$

$\lim_{h\to0} \frac{f(h)-f(0)}{h} = \lim_{h\to0} \frac{h^2 \log\cos h - 0}{\log(1+h)}$

$\lim_{h\to0} \frac{h^2 \log(\cos h)}{1} = 0$

$\therefore f(x)$ is differentiable at $x = 0$

$$f(x) = \begin{cases} 4 & -\infty < x < -\sqrt{5} \\ x^2 - 1 & -\sqrt{5} \le x \le \sqrt{5} \\ 4 & \sqrt{5} < x < \infty \end{cases}$$

Af. k 2 is the number of points whe re *f*(x) is not differentiable then k – 2 =

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Here $f(x)$ is continous $\forall x \in \mathbf{R}$

Now At $x = -\sqrt{5}$

L.H.D = 0

R.H.D $= 2x = -2\sqrt{5}$

$\Rightarrow \mathbf{f(x)}$ is not differentiable at $\mathbf{x} = -\sqrt{5}$

At $x = \sqrt{5}$

L.H.D. $= 2x = 2\sqrt{5}$

R.H.D. $= \mathbf{0}$

$\Rightarrow \mathbf{f(x)}$ is not differentiable at $\mathbf{x} = \sqrt{5}$

$\Rightarrow \mathbf{k} = \mathbf{2}$

$k - 2 = 2 - 2 = 0$

If $x\sqrt{1+y} + y\sqrt{1+x} = 0$, then $\frac{dy}{dx} =$

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$$\text{Given, } x\sqrt{1+y} + y\sqrt{1+x} = 0$$
$$\Rightarrow \quad x\sqrt{1+y} = -y\sqrt{1+x}$$
$$\Rightarrow \quad (x\sqrt{1+y})^2 = (-y\sqrt{1+x})^2$$
$$\Rightarrow \quad x^2(1+y) = y^2(1+x)$$
$$\Rightarrow \quad x^2 - y^2 = y^2x - x^2y$$
$$\Rightarrow \quad (x-y)(x+y) = xy(y-x)$$
$$\Rightarrow \quad x+y = -xy$$
$$\Rightarrow \quad x+y+xy = 0$$
$$\Rightarrow \quad y = \frac{-x}{1+x} = -1 + \frac{1}{1+x}$$

Differentiating w.r.t, x

$$\frac{dy}{dx} = -\frac{1}{(1+x)^2}$$

If $y = \tan^{-1}\left(\frac{\sqrt{x}-x}{1+x^{\frac{3}{2}}}\right)$, then $y'(1)$ is equal to

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$$y = \tan^{-1}\left(\frac{\sqrt{x}-x}{1+x^{\frac{3}{2}}}\right)$$

Given, $y = \tan^{-1}\left(\frac{\sqrt{x}-x}{1+\sqrt{x}\cdot x}\right)$

$$y = \tan^{-1}(\sqrt{x}) - \tan^{-1}x$$
$$\left[\because \tan^{-1}\left(\frac{x-y}{1+xy}\right) = \tan^{-1}x - \tan^{-1}y\right]$$

Differentiating w.r.t x

$$y'(x) = \frac{dy}{dx} = \frac{1}{1+x} \times \frac{1}{2\sqrt{x}} - \frac{1}{1+x^2}$$

Now, $y'(1) = \frac{1}{2} \times \frac{1}{2} - \frac{1}{2} = -\frac{1}{4}$

At $x = \frac{\pi^2}{4}$, $\frac{d}{dx}\left(\tan^{-1}(\cos\sqrt{x}) + \sec^{-1}(e^x)\right) =$

84. $\frac{1}{\sqrt{e^{\frac{\pi^2}{2}} - 1}} - \frac{1}{\pi}$

A.

$\frac{\pi}{4} + \frac{1}{\sqrt{e^{\pi^2} + e^{\pi^2/2}}}$

B.

C. $\frac{1}{\sqrt{e^{\pi^2} + e^{\pi^2/2}}} + \frac{2}{\pi}\cot\left(\frac{\sqrt{\pi}}{2}\right)$

$\frac{1}{\sqrt{e^{\pi}}} + \frac{1}{\pi}$

Son lsu. tAio n:

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$$\frac{d}{dx}\left(\tan^{-1}(\cos\sqrt{x}) + \sec^{-1}(e^x)\right)$$

$$= \frac{(-\sin\sqrt{x})}{1+\cos^2\sqrt{x}} \cdot \left(\frac{1}{2\sqrt{x}}\right) + \frac{1}{e^x\sqrt{e^{2x}-1}} \cdot e^x$$

but when $x = \frac{\pi^2}{4}$

$$= -\frac{-\sin\frac{\pi}{2}}{1+\cos^2\frac{\pi}{2}}\left(\frac{1}{2}\right)\left(\frac{2}{\pi}\right) + \frac{1}{\sqrt{e^{\pi^2/2}-1}}$$

$$= -\frac{1}{\pi} + \frac{1}{\sqrt{e^{\pi^2/2}-1}}$$

he maximum area of rectangl e inscribed in a circle of diameter R is

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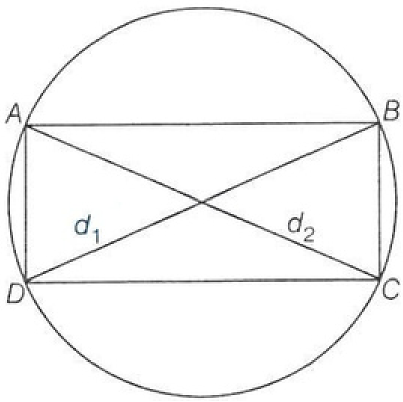

Diameter = R

Diagonals, $d_1 = d_2 = R$

Max Area of rectangle (any quadrilateral) $= \frac{1}{2} d_1 \times d_2$

$= \frac{1}{2} \times R \times R = \frac{R^2}{2}$ then $f(x)$ is

$\frac{|x-1|}{x^2}$

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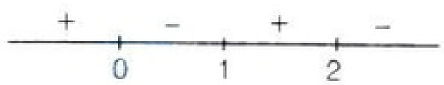
Given, $f(x)=\begin{cases}\dfrac{x-1}{x^2}; x\geq 1\\ \dfrac{-x+1}{x^2}; x<1\end{cases}$

$$f(x)=\begin{cases}\frac{1}{x}-\frac{1}{x^2}; & x\geq 1\\ -\frac{1}{x}+\frac{1}{x^2}; & x<1\end{cases}$$

$$f'(x)=\begin{cases}\frac{-1}{x^2}+\frac{2}{x^3}; & x\geq 1\\ \frac{1}{x^2}-\frac{2}{x^3}; & x<1\end{cases}$$

$$f'(x)=\begin{cases}\frac{2-x}{x^3}; & x\geq 1\\ \frac{x-2}{x^3}; & x<1\end{cases}$$

By observation, $f'(x)$ will be



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tse i s(incu.)u nits) of the cylinder which can be inscribed in a

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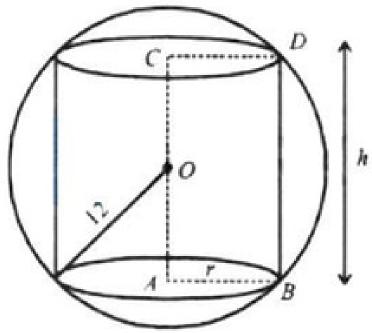
$$12^2=r^2+\left(\frac{h}{2}\right)^2\Rightarrow V=\pi r^2 h$$

$$\Rightarrow \quad V=\pi\left(144-\frac{h^2}{4}\right)h$$



$\Rightarrow \quad V = 144\pi h - \frac{\pi}{4}h^3 \Rightarrow \frac{dV}{dh} = 144\pi - \frac{3\pi}{4}h^2$

$\Rightarrow \frac{dV}{dh} = 0 \Rightarrow 144\pi = \frac{3\pi}{4}h^2$

$\Rightarrow \quad h^2 = 48 \times 4 \Rightarrow h = 8\sqrt{3}$

$\therefore \quad 12^2 = r^2 + 48 \Rightarrow r^2 = 96$

Volume $= \pi r^2 h = \pi \times 96 \times 8\sqrt{3} = 768\sqrt{3}\pi \text{ cm}^3$.

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(816o+s8,t yn1)f e=*t* a 1n *t*

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$x = 12(t + \sin t \cos t), y = 12(1 + \sin t)^2$

Differentiate w.r.t ' t ',

$$\frac{dx}{dt} = 12\left(1 + \cos^2 t - \sin^2 t\right)$$
$$\frac{dx}{dt} = 12(1 + \cos 2t) \text{ and } \frac{dy}{dt}$$
$$= 24(1 + \sin t)\cos t$$
$$\frac{dy}{dx} = \frac{2(1 + \sin t) \times \cos t}{1 + \cos 2t}$$

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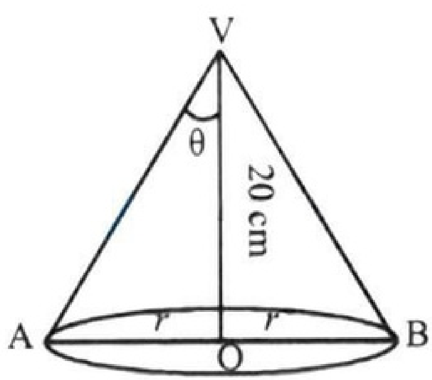

$\Rightarrow \quad \frac{dr}{dt} = 20\sec^2\theta\frac{d\theta}{dt}$

$\Rightarrow \quad \frac{dr}{dt} = 20\sec^2 30^\circ \times 2$

$[\because \theta = 30^\circ$ and $\frac{d\theta}{dt} = 2]$

$\Rightarrow \quad \frac{dr}{dt} = 20 \times \frac{4}{3} \times 2\ \text{cm/s} = \frac{160}{3}\ \text{cm/s}$

of inflexion for the c urve y = (x − a)n, where n is odd integer and n ≥

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tio n:

Here $\frac{d^2y}{dx^2} = n(n-1)(x-a)^{n-2}$

Now, $\frac{d^2y}{dx^2} = 0 \Rightarrow x = a$

Differentiating equation of the curve n times,

we get, $\frac{d^ny}{dx^n} = n!$

$\therefore \quad$ at $x = a$, $\frac{d^ny}{dx^n} \neq 0$ and $\frac{d^{n-1}y}{dx^{n-1}} = 0$,

where n is odd.

Therefore $(a, 0)$ is the point of inflexion

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$$\frac{dp(t)}{dt} = 0.5p(t) - 450$$

$$\Rightarrow \frac{dp(t)}{dt} = \frac{1}{2}p(t) - 450$$

$$\Rightarrow \quad \frac{dp(t)}{dt} = \frac{p(t)-900}{2}$$

$$\Rightarrow \quad 2\frac{dp(t)}{dt} = -[900 - p(t)]$$

$$\Rightarrow \quad 2\frac{dp(t)}{900-p(t)} = -dt$$

Integrate both the side, we get :

$$-2\int \frac{dp(t)}{900-p(t)} = \int dt$$

Let $900 - p(t) = u \Rightarrow -dp(t) = du$

$\therefore$ We have; $2\int \frac{du}{u} = \int dt \Rightarrow 2\ln u = t + c$

$\Rightarrow \quad 2\ln[900 - p(t)] = t + c$ when $t = 0, p(0) = 850$

$2\ln(50) = c \quad \Rightarrow 2\left[\ln\left(\frac{900-p(t)}{50}\right)\right] = t$

$$\Rightarrow \quad 900 - p(t) = 50e^{\frac{t}{2}}$$

$$\Rightarrow \quad p(t) = 900 - 50e^{\frac{t}{2}}$$

let $p(t_1) = 0$

$0 = 900 - 50e^{\frac{t_1}{2}} \quad \therefore t_1 = 2\ln 18$

$\int \frac{x^3-1}{x^3+x}dx =$

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(x) + c

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$$I=\int\left(\frac{x^3-1}{x^3+x}\right)dx=\int\left(1-\frac{x+1}{x^3+x}\right)dx$$

$$\Rightarrow I=\int 1\cdot dx-\int\frac{(x+1)}{x^3+x}dx$$
$$=x-\int\frac{(x+1)}{x\left(x^2+1\right)}dx$$

$$\text{Let }\frac{x+1}{x\left(x^2+1\right)}=\frac{A}{x}+\frac{Bx+C}{x^2+1}$$
$$\Rightarrow(x+1)=A\left(x^2+1\right)+(Bx+C)x$$
$$\Rightarrow(x+1)=(A+B)x^2+Cx+A$$

On comparing coefficient, we get

$$A+B=0, C=1, A=1$$
$$\Rightarrow B=-1$$
$$\therefore I=x-\int\frac{1}{x}dx-\int\frac{(1-x)}{x^2+1}dx$$
$$\Rightarrow I=x-\log|x|-\int\frac{1}{x^2+1}dx+\frac{1}{2}\int\frac{2x}{x^2+1}dx$$
$$\Rightarrow I=x-\log|x|-\tan^{-1}x+\frac{1}{2}\log\left(x^2+1\right)+c$$

$$\int\sqrt{x+\sqrt{x^2+2}}dx=$$

93. $\frac{3}{2}(x+\sqrt{x+2})^{3/2}-2\left(x+\sqrt{x^2+2}\right)^{1/4}+C$

A. $\frac{1}{3}\left(x+\sqrt{x^2+2}\right)^{3/2}-2\left(x+\sqrt{x^2+2}\right)^{1/4}+C$

B. $\left(x+\sqrt{x^2+2}\right)^{-3/2}-2\left(x+\sqrt{x^2+2}\right)^{-1/2}+C$

C.

$$\frac{\left(x+\sqrt{x^2+2}\right)^2-6}{3\sqrt{x+\sqrt{x^2+2}}}+C$$

Son. lsu. tDio n:
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$$\int\sqrt{x+\sqrt{x^2+2}}dx$$

$$\sqrt{x+\sqrt{x^2+2}}=t\Rightarrow x+\sqrt{x^2+2}=t^2$$

$$\sqrt{x^2+2}=t^2-x$$

$$\Rightarrow x^2+2=t^4+x^2-2t^2x$$

$$\Rightarrow \mathrm{x}=\frac{t^4-2}{2t^2}\Rightarrow \mathrm{dx}=\frac{t^4+2}{t^3}\mathrm{dt}$$

$$\int t\cdot\frac{t^4+2}{t^3}\mathrm{dt}=\int\left(t^2+\frac{2}{t^2}\right)\mathrm{dt}=\frac{t^3}{3}-\frac{2}{t}+\mathrm{C}$$

$$=\frac{t^3}{3}-\frac{2}{t}+C=\frac{t^4-6}{3t}+C$$

$$=\frac{\left(x+\sqrt{x^2+2}\right)^2-6}{3\sqrt{x+\sqrt{x^2+2}}}+C$$

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tanθ

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Solsu.tD

Let $I = \int e^{\tan\theta}(\sec\theta - \sin\theta)d\theta$

Put $\tan\theta = t \Rightarrow \sec^2\theta d\theta = dt \Rightarrow d\theta = \frac{dt}{1+t^2}$

$\Rightarrow I = \int e^t \left(\sqrt{1+t^2} - \frac{t}{\sqrt{1+t^2}}\right) \frac{dt}{1+t^2}$

$= \int e^t \left(\frac{1}{\sqrt{1+t^2}} - \frac{t}{(1+t^2)^{3/2}}\right) dt$

Integrating first part by parts we have,

$= \frac{1}{\sqrt{1+t^2}} e^t + \int \frac{t}{(1+t^2)^{3/2}} \cdot e^t dt$

$- \int \frac{t}{(1+t^2)^{3/2}} e^t dt + c$

$= \frac{e^t}{\sqrt{1+t^2}} + c = e^{\tan\theta}\cos\theta + c$

$\int_0^\infty \frac{dx}{(x^2+a^2)(x^2+b^2)}$ is

Q.5 A. $\frac{\pi ab}{a+b}$

C $\frac{ab}{2(a+b)}$

B. $\frac{\pi}{2ab(a+b)}$

.. $\frac{\pi(a+b)}{2ab}$

A io n:

Solu. tC

$$I = \int_0^\infty \frac{1}{(x^2+a^2)(x^2+b^2)} dx$$
$$I = \frac{1}{a^2-b^2} \int_0^\infty \frac{(x^2+a^2)-(x^2+b^2)}{(x^2+a^2)(x^2+b^2)} dx$$
$$I = \frac{1}{a^2-b^2} \int_0^\infty \frac{1}{(x^2+b^2)} - \frac{1}{(x^2+a^2)} dx$$
Let $$I = \frac{1}{a^2-b^2} \left[\frac{1}{b}\tan^{-1}\frac{x}{b} - \frac{1}{a}\tan^{-1}\frac{x}{a}\right]_0^\infty$$
$$I = \frac{1}{a^2-b^2} \left[\frac{1}{b} \times \frac{\pi}{2} - \frac{1}{a} \times \frac{\pi}{2}\right]$$
$$I = \frac{1}{(a+b)(a-b)} \left[\frac{a-b}{ab}\right] \times \frac{\pi}{2}$$
$$I = \frac{\pi}{2ab(a+b)}$$

he value of definite integral $\int_0^{\pi/2}$ log(tan x)dx is

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Sonlsu. tAio n:

Let $I = \int_0^{\frac{\pi}{2}} \log(\tan x) dx$....(i)

By applying property,

$$\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$$

$$I = \int_0^{\frac{\pi}{2}} \log\left(\tan\left(\frac{\pi}{2} - x\right)\right) dx$$

$$I = \int_0^{\frac{\pi}{2}} \log(\cot x) dx \ldots (ii)$$

Adding Eqs. (i) and (ii),

$$2I = \int_0^{\frac{\pi}{2}} [\log(\tan x) + \log(\cot x)] dx$$

$$2I = \int_0^{\frac{\pi}{2}} \log 1 dx = 0$$

$\int_5^9 \frac{\log 3x^2}{\log 3x^2 + \log(588 - 84x + 3x^2)} dx$ is equal to

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Sonls.u tAio n:

Let

$I=\int_5^9 \frac{\log 3x^2 dx}{\log 3x^2+\log(588-84x+3x^2)}$ ...(i)

$$=\int_5^9 \frac{\log 3x^2 dx}{\log 3x^2+\log 3(14-x)^2}$$
$$=\int_5^9 \frac{\log 3(14-x)^2 dx}{\log 3(14-x)^2+\log 3(14-(14-x))^2}$$
$$\left[\int_a^b f(x)dx=\int_a^b f(a+b-x)dx\right]$$

$I=\int_5^9 \frac{\log 3(14-x)^2 dx}{\log 3(14-x)^2+\log 3x^2}$ ...(ii)

Adding Eqs. (i) and (ii), we get

$$2I=\int_5^9 \frac{\log 3x^2+\log 3(14-x)^2}{\log 3(14-x)^2+\log 3x^2}dx$$
$$2\text{I}=\int_5^9 dx=9-5=4 \Rightarrow I=2$$ is equa l to

BA. . The integral $\int \frac{x^2(x\sec^2 x+\tan x)}{(x\tan x+1)^2}dx$

98 $-\frac{x^2}{x\tan x+1}+c$

C.. 2 loge |xsin x + cosx| + c

$-\frac{x^2}{x\tan x+1}+2\log_e|x\sin x+\cos x|+c$

$\frac{x^2}{x^2\tan x-1}-2\log_e|x\sin x+\cos x|+c$

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$\frac{d}{dx}(x\tan x+1)=x\sec^2 x+\tan x$

$\therefore$ integrating by parts with x^2 as first function, we get

$$I=\int x^2\frac{x\sec^2 x+\tan x}{(x\tan x+1)^2}dx$$
$$=x^2\left(-\frac{1}{x\tan x+1}\right)-\int 2x\left(-\frac{1}{x\tan x+1}\right)dx$$
$$=-\frac{x^2}{x\tan x+1}+2\int\frac{x\cos x}{x\sin x+\cos x}dx$$
$$=-\frac{x^2}{x\tan x+1}+2\log_e|x\sin x+\cos x|+c$$
$$\left(\because \frac{d}{dx}(x\sin x+\cos x)=x\cos x\right)$$

$\lim_{n\to\infty}\prod_{r=3}^{\infty}\frac{r^3-8}{r^3+8}$ equals to

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$$\lim_{n\to\infty}\prod_{r=3}^{\infty}\frac{r^3-8}{r^3+8}=\left(\frac{3^3-8}{3^3+8}\right)\left(\frac{4^3-8}{4^3+8}\right)$$
$$\ldots\ldots\ldots\left(\frac{n^3-8}{n^3+8}\right)$$

$$=\lim_{n\to\infty}\left[\frac{(3-2)(3^2+2^2+3.2)}{(3+2)(3^2+2^2-3.2)}\right]\left[\frac{(4-2)(4^2+2+4.2)}{(4+2)(4^2+2^2-4.2)}\right]$$
$$\ldots\ldots\ldots\ldots\left[\frac{(n-2)(n^2+2^n+n.2)}{(n+2)(n^2+2^2-n.2)}\right]$$

$$=\lim_{n\to\infty}\left[\frac{(3-2)(4-2)\ldots\ldots\ldots(n-2)}{(3+2)(4+2)\ldots\ldots\ldots(n+2)}\right]$$
$$\left[\frac{(3^2+2^2+3.2)(4^2+2^2+4.2)\ldots\ldots\ldots(n^2+2^2+n.2)}{(3^2+2^2-3.2)(4^2+2^2-4.2)\ldots\ldots\ldots(n^2+2^2-n.2)}\right]$$

$$=\left[\frac{1\cdot2\cdot3.4.5.6.\ldots\ldots\ldots}{5\cdot6.7.8.\ldots\ldots\ldots}\right]\left[\frac{19\cdot28\cdot39.52.63.\ldots\ldots\ldots}{7\cdot12\cdot19.28.39.52.\ldots\ldots\ldots}\right]$$

$$=\frac{2}{7}$$

$$\int_0^{\frac{\pi}{2}} \frac{\sin\left(\frac{\pi}{4}+x\right)+\sin\left(\frac{3\pi}{4}+x\right)}{\cos x+\sin x} dx =$$

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$$\text{Let } I = \int_0^{\frac{\pi}{2}} \frac{\sin\left(\frac{\pi}{4}+x\right)+\sin\left(\frac{3\pi}{4}+x\right)}{\cos x+\sin x} dx$$

$$\Rightarrow I = \int_0^{\pi/2} \frac{\sin\left(\frac{3\pi}{4}-x\right)+\sin\left(\frac{5\pi}{4}-x\right)}{\sin x+\cos x} dx$$

$$\Rightarrow I = \int_0^{\pi/2} \frac{\sin\left(\frac{\pi}{4}+x\right)-\sin\left(\frac{3\pi}{4}+x\right)}{\cos x+\sin x} dx$$

$$\text{Now } I + I = \int_0^{\pi/2} \frac{2\sin\left(\frac{\pi}{4}+x\right)}{\cos x+\sin x} dx$$

$$\Rightarrow I = \int_0^{\pi/2} \frac{\frac{1}{\sqrt{2}}\cos x+\frac{1}{\sqrt{2}}\sin x}{\cos x-\sin x} dx = \frac{\pi}{2\sqrt{2}}$$

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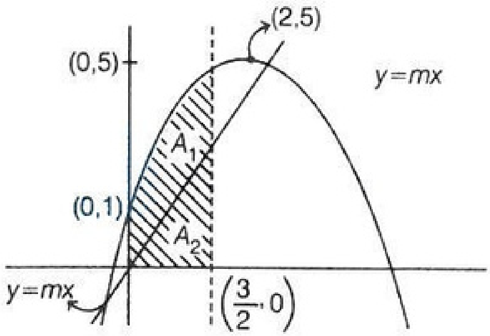
Given, $y = 1 + 4x - x^2$

$$\Rightarrow \quad \frac{dy}{dx} = 4 - 2x = 0 \Rightarrow x = 2 [\text{point of maxima}]$$

$$\Rightarrow \quad y_{\max} = 1 + 4 \times 2 - 4 = 5$$

when $x = 0, y = 1$

∴ Graph according to question and above i nformation



$\Rightarrow$ **If $y = mx$ bisects the area bounded**

$$\Rightarrow \quad A_1 = A_2$$

$$\Rightarrow \quad \int_0^{3/2} \left(1 + 4x - x^2\right) dx = 2 \int_0^{3/2} mx dx$$

$$\Rightarrow \quad \left[x + 2x^2 - \frac{x^3}{3}\right]_0^{3/2} = \left[mx^2\right]_0^{3/2}$$

$$\Rightarrow \frac{3}{2} + 2 \times \frac{9}{4} - \frac{27}{8} \times \frac{1}{3} = m \times \frac{9}{4}$$

$$\therefore \quad m = \frac{13}{6}$$

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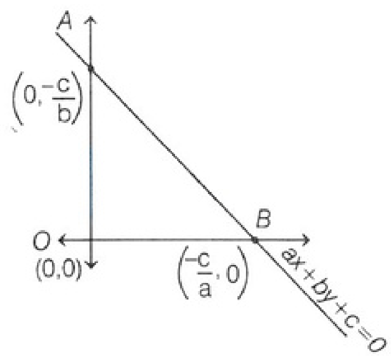

$$\therefore \text{ Area of } \triangle OAB = \left|\frac{1}{2} \times OA \times OB\right|$$
$$= \left|\frac{1}{2} \times \left(\frac{-c}{b}\right) \times \left(\frac{-c}{a}\right)\right|$$
$$= \frac{1}{2} \times \frac{c^2}{ab} = \frac{1}{2} [by Eq. (i)]$$

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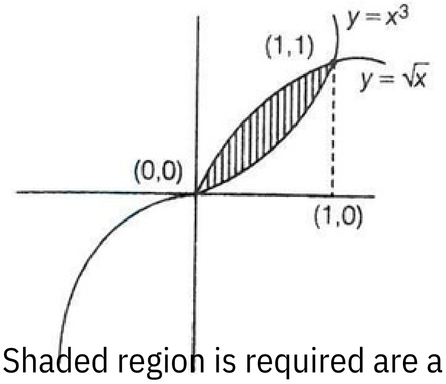

Shaded region is required are a

A104 4The area of the region bounded by the curves x = y2 − 2 and x = y is

$$A = \left|\int_0^1 (x^3 - \sqrt{x})\, dx\right| = \left|\left[\frac{x^4}{4} - \frac{2x^{3/2}}{3}\right]_0^1\right|$$

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$$= \left|\left[\frac{1}{4} - \frac{2}{3}\right]\right|$$

$$= \frac{5}{12} \text{ sq. unit}$$

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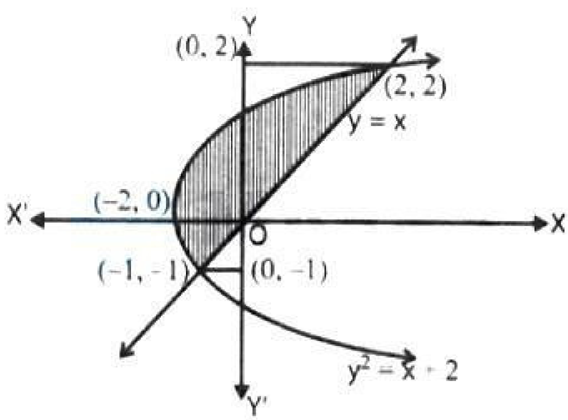

On solving, $x = y^2 - 2$ and $x = y$, we get $(-1, -1)$ and $(2, 2)$.

Area of the shaded region,

$$A = \int_{-1}^{2} y\,dy - \int_{-1}^{2} \left(y^2 - 2\right) dy$$
$$= \left[\frac{y^2}{2} - \frac{y^3}{3} + 2y\right]_{-1}^{2} = \left(\frac{4}{2} - \frac{8}{3} + 4\right) - \left(\frac{1}{2} + \frac{1}{3} - 2\right)$$
$$= \frac{10}{3} + \frac{7}{6} = \frac{27}{6} = \frac{9}{2}$$

frea bounded by the curves y = ax2 and x = ay2, (a > 0) is 3 sq units, then

a is

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a lu .e..o..(fyi=) b y Eq. (i) in Eq. (ii), we get

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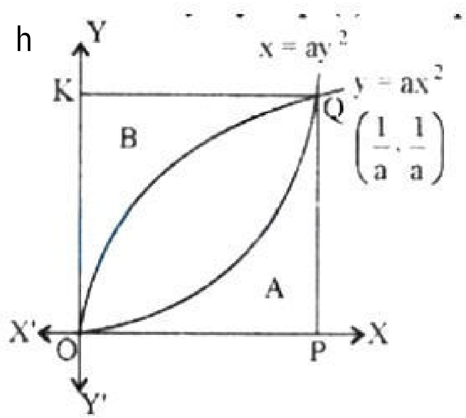

$$x = a \times a^2 x^4 \Rightarrow x^4 a^3 - x = 0$$

$$x\left(x^3 a^3 - 1\right) = 0 \Rightarrow x = 0, \frac{1}{2}$$

When, $x = 0 \Rightarrow y = 0$ and $x = \frac{1}{a} \Rightarrow y = \frac{1}{a}$

Here, points of intersection of curves $y = ax^2$

and $x = ay^2$ are $(0, 0)$ and $\left(\frac{1}{a}, \frac{1}{a}\right)$.

$\therefore$ Required area

$$A = \int_{x=a}^{x=b} \left[f_2(x) - f_1(x)\right] dx$$

$$3 = \int_0^{1/a} \left(\frac{\sqrt{x}}{\sqrt{a}} - ax^2\right) dx$$

$$3 = \left[\frac{1}{\sqrt{a}} \times \frac{2}{3} x^{3/2} - \frac{ax^3}{3}\right]_0^{1/a}$$

$$3 = \frac{2}{3\sqrt{a}}\left[\left(\frac{1}{a}\right)^{3/2}\right] - \frac{a}{3}\left[\left(\frac{1}{a}\right)^3\right]$$

$$3 = \frac{2}{3\sqrt{a}} \times \frac{1}{a\sqrt{a}} - \frac{a}{3} \times \frac{1}{a^3}$$

$$3 = \frac{2}{3a^2} - \frac{1}{3a^2} \Rightarrow 3 = \frac{2-1}{3a^2} \Rightarrow 9a^2 = 1$$

$a^2 = \frac{1}{9} \Rightarrow a = \frac{1}{3}$ olut ion of the differential equation (x + 1)dy/dx − y = e

(x + 1)2 is

3x

A10 yb = (xe (sx+ + 1 1)e)3 +x + e 3Cx

+ C

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$\frac{3y}{x+1} = e^{3x} + C$

ADn. yse−3x = 3(x + 1) + C

Solu. tCio n:

Given, $\frac{dy}{dx} - \frac{y}{x+1} = e^{3x}(x+1)$

Above is linear differential equation of form

$$\frac{dy}{dx} + Px = Q$$

$$\therefore \quad \text{IF} = e^{\int P dx} = e^{\int -\frac{1}{x+1} dx} = e^{-\ln(1+x)} = \frac{1}{1+x}$$

⇒ Solution will be

$$y \cdot \text{IF} = \int Q \cdot \text{IF} dx$$

$$y \cdot \frac{1}{1+x} = \int e^{3x}(x+1) \times \frac{1}{(1+x)} dx$$

$$\frac{y}{1+x} = \frac{e^{3x}}{3} + C'$$

$$\frac{3y}{1+x} = e^{3x} + C' \qquad [\because C = 3C']$$

(cos x – 1) loge 2, then y

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c2d2x y loge 2 = 2^{sinx}

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$$\frac{dy}{dx} - y \log_e 2 = 2^{\sin x}(\cos x - 1) \log_e 2$$

This is linear differential equation

$$\text{I.F.} = e^{-\log_e 2 \int dx} = e^{-x \log_e 2} = 2^{-x}$$

then general Solution is

$$y2^{-x} = \int 2^{-x} 2^{\sin x}(\cos x - 1) \log_e 2 dx + c$$

Now let $\sin x - x = t \Rightarrow (\cos x - 1)dx = dt$

$$\therefore y2^{-x} = \log_e 2 \int 2^t dt + c$$

$$\therefore y2^{-x} = 2^t + c$$

$$\therefore y = 2^{x+t} + c2^x$$

$$\therefore y = 2^{\sin x} + c2^x$$

Let $\mathbf{a} = \hat{\mathbf{i}} - \hat{\mathbf{k}}, \mathbf{b} = x\hat{\mathbf{i}} + \hat{\mathbf{j}} + (1-x)\hat{\mathbf{k}}$ and $\mathbf{c} = y\hat{\mathbf{i}} + x\hat{\mathbf{j}} + (1+x-y)\hat{\mathbf{k}}$. Then, $[\mathbf{ab}\ \mathbf{c}]$ depends on

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Here, $[abc] = |a \cdot (b \times c)|$

Now, according to question,

$$[a \quad bc] = \begin{vmatrix} 1 & 0 & -1 \\ x & 1 & 1-x \\ y & x & 1+x-y \end{vmatrix}$$
$$= 1(1+x-y-x(1-x)) - 1\left(x^2-y\right)$$
$$= 1+x-y-x+x^2-x^2+y$$
$$= 1$$
$$= \text{ Independent of } x \text{ and } y.$$

ns eBerF n ainll yth atehn reda pst $\vec{a}, \vec{b}, \vec{c}$

Ae dt . ctor of etCanbeCtrFha.i ItafinEog 3dle i:veEa1bcdnie3dvtb:od 2ne ivAnetDcetrionnr atslh loyef trAha,et
1Le09iBEdemet ABeB
D FCsi A

v $\frac{\vec{a}+\vec{b}+\vec{c}}{3}$

B. $\frac{\vec{a}-2\vec{b}+3\vec{c}}{2}$

C. $\frac{\vec{a}+2\vec{b}+3\vec{c}}{2}$

$\frac{\vec{a}-\vec{b}+3\vec{c}}{3}$

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$\overrightarrow{OA} = \vec{a}, \overrightarrow{OB} = \vec{b}, \overrightarrow{OC} = \vec{c}$

Now P.V of D i.e $\overrightarrow{OD} = \frac{1\times\overrightarrow{OB}+3\times\overrightarrow{OC}}{1+3}$

$$\overrightarrow{OD} = \frac{\vec{b} + 3\vec{c}}{4}$$

$$\overrightarrow{OE} = \frac{4\overrightarrow{OD} + \overrightarrow{OA}}{4+1} = \frac{\frac{4(\vec{b}+3\vec{c})}{4} + \vec{a}}{5}$$

$$\Rightarrow \overrightarrow{OE} = \frac{\vec{a} + \vec{b} + 3\vec{c}}{5}$$

$$\text{Now, } \overrightarrow{OE} = \frac{2\overrightarrow{OB} + 3\overrightarrow{OF}}{2+3}$$

$$\Rightarrow \overrightarrow{OF} = \frac{5\overrightarrow{OE} - 2\overrightarrow{OB}}{3}$$

$$\Rightarrow \overrightarrow{OF} = \frac{\frac{5(\vec{a}+\vec{b}+3\vec{c})}{5} - 2\vec{b}}{3}$$

$$\Rightarrow \overrightarrow{OF} = \frac{\vec{a} - \vec{b} + 3\vec{c}}{3} \Rightarrow P.V. \text{ of F is } \frac{\vec{a} - \vec{b} + 3\vec{c}}{3}$$

110. If $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$, then the value of

$$|\hat{i} \times (\vec{a} \times \hat{i})|^2 + |\hat{j} \times (\vec{a} \times \hat{j})|^2 + |\hat{k} \times (\vec{a} \times \hat{k})|^2$$

is equal to

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$$\hat{i} \times (\bar{a} \times \hat{i}) = (\hat{i} \cdot \hat{i})\bar{a} - (\hat{i} \cdot \bar{a})\hat{i} = \hat{j} + 2\hat{k}$$

$$\text{Similarly, } \hat{j} \times (\bar{a} \times \hat{j}) = 2\hat{i} + 2\hat{k}$$

$$\hat{k} \times (\bar{a} \times \hat{k}) = 2\hat{i} + \hat{j}$$

$$\Rightarrow \|\hat{j} + 2\hat{k}|^2 + |2\hat{i} + 2\hat{k}|^2 + |2\hat{i} + \hat{j}|^2$$

$$= 5 + 8 + 5 = 18$$

f iejoining (3,4, 5) and (4,6,3) on the line

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We know that, projection of $\mathbf{a}$ on $\mathbf{b}$ is given by projection, $|\mathbf{a}|\cos\theta = \frac{(\mathbf{a}\cdot\mathbf{b})}{|\mathbf{b}|}$

Let line joining points $(3,4,5)$ and $(4,6,3)$ is L_1 and line joining points $(-1,2,4)$ and $(1,0,5)$ is L_2

$$\Rightarrow \quad \begin{aligned} L_1 &= \hat{\mathbf{i}} + 2\hat{\mathbf{j}} - 2\hat{\mathbf{k}} \\ L_2 &= 2\hat{\mathbf{i}} - 2\hat{\mathbf{j}} + \hat{\mathbf{k}} \end{aligned}$$

$\therefore$ Projection of L_1 and $L_2 = \frac{L_1 \cdot L_2}{|L_2|}$

$$= \frac{2-4-2}{\sqrt{4+4+1}} = \frac{-4}{3}$$

$\therefore$ Magnitude $= \frac{4}{3}$

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$\cos^{-1}\left(\frac{1}{6}\right)$

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$\cos^{-1}\left(-\frac{1}{6}\right)$

C

$\cos^{-1}\left(\frac{2}{3}\right)$

AD.. $\cos^{-1}\left(-\frac{5}{6}\right)$

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a3l + m + 5n w e2 n=al

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th+e l)(r(−3 − l − 5n) = 0

⇒ (=nl−n l5) r0−n 5l(−3

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$\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{-1}{\sqrt{6}}$ or $\frac{-2}{\sqrt{6}}, \frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}$. The angle θ

between the lines is given by

$$\cos\theta = \frac{1}{\sqrt{6}} \times \frac{-2}{\sqrt{6}} + \frac{2}{\sqrt{6}} \times \frac{1}{\sqrt{6}} + \frac{-1}{\sqrt{6}} \times \frac{1}{\sqrt{6}} = \frac{-1}{6}$$

$$\Rightarrow \theta = \cos^{-1}\left(\frac{-1}{6}\right)$$

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Sonls4utB0io n:

Given that $P_1 : x - 2y - 2z + 1 = 0$

$P_2 : 2x - 3y - 6z + 1 = 0$

Equation of plane bisectors

$$\left|\frac{x-2y-2z+1}{\sqrt{1+4+4}}\right| = \left|\frac{2x-3y-6z+1}{\sqrt{2^2+3^2+6^2}}\right|$$
$$\frac{x-2y-2z+1}{3} = \pm\frac{2x-3y-6z+1}{7}$$

Since $a_1a_2 + b_1\,b_2 + c_1c_2 = 20 > 0$

∴ Negative sign will be taken for acute bisector.

$$\Rightarrow 7x - 14y - 14z + 7 = -[6x - 9y - 18z + 3]$$
$$\Rightarrow 13x - 23y - 32z + 10 = 0$$
$$\left(-2, 0, -\frac{1}{2}\right) \text{ satisfy it}$$

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$L : \frac{x}{1} = \frac{y}{0} = \frac{z}{-1}$ ℡ a ob tt ep Noi.n Ltet aulia n ttoh eths lein elsa PnNe xa n+d y P +Q

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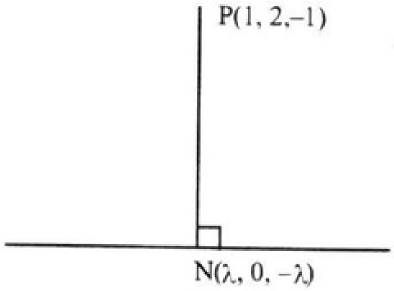
Let $\frac{x}{1} = \frac{y}{0} = \frac{z}{-1} = \lambda$

$\Rightarrow N(\lambda, 0, -\lambda)$

$\vec{b} = \hat{i} - \hat{k}$



$\because \overrightarrow{PN} \cdot \vec{b} = 0$

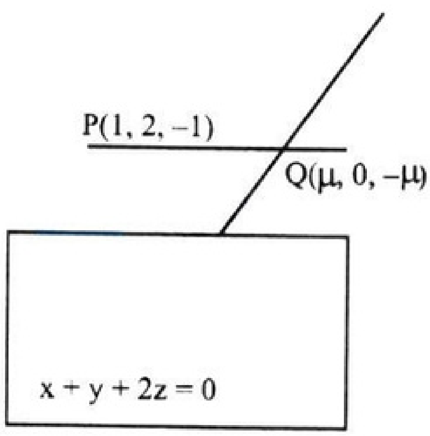
$\Rightarrow 1(1-\lambda) - (\lambda - 1) = 0 \Rightarrow \lambda = 1$

$\Rightarrow N(1, 0, -1)$

Let $Q(\mu, 0, -\mu)$

$\because \vec{n} = \hat{i} + \hat{j} + 2\hat{k}$

Now,



$\because \overrightarrow{PQ} \cdot \vec{n} = 0$

$\Rightarrow \mu = -1$

$\Rightarrow Q(-1, 0, 1)$

$\overrightarrow{PN} = 2\hat{j}$ and $\overrightarrow{PQ} = 2\hat{i} + 2\hat{j} - 2\hat{k}$

$\Rightarrow \cos\alpha = \frac{1}{\sqrt{3}}$

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Nol, inounut:mcobmere osf = ca 2s1e6s of getting 10 from 3 dices in single throw are

Case $1: \ 1+3+6 \rightarrow$ outcomes $= 3! = 6$

Case $2: \ 1+4+5 \rightarrow$ outcomes $= 3! = 6$

Case $3: \ 2+2+6 \rightarrow$ outcomes $= \frac{3!}{2!} = 3$

Case $4: \ 2+3+5 \rightarrow$ outcomes $= 3! = 6$

Case $5: \ 2+4+4 \rightarrow$ outcomes $= \frac{3!}{2!} = 3$

Case $6: \ 3+3+4 \rightarrow$ outcomes $= \frac{3!}{2!} = 3$

Favourable outcomes $= 27$

$\therefore$ Probability $= \frac{27}{216} = \frac{1}{8}$

$\Rightarrow \quad (x+24)(x-20) = 0$

$\Rightarrow \quad x = 20$

A11 In a binomial distribution, the mean is 4 and variance is 3. Then, its mode is

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$$\begin{aligned} \text{Mean } &= np = 4 \\ \text{Variance } &= npq = 3 \\ \Rightarrow \quad q &= \frac{3}{4} \end{aligned}$$

and

$p = 1 - q = 1 - \frac{3}{4} = \frac{1}{4}$

$\Rightarrow \quad n = 16$

Now, Mode of Binomial distribution is given by $(n+1)P$

Case IIf $(n+1)P = \text{Integer}(I)$, then Mode $= \{I, I-1\}$

Case II If $(n+1)P \neq \text{Integer}(I+f)$, then Mode $= \{I\}$

$$\begin{aligned} \therefore (n+1)P &= (16+1)\frac{1}{4} \\ &= \frac{17}{4} = 4.25 \\ &= 4 + 0.25 \\ \Rightarrow \text{ Mode } &= 4 \end{aligned}$$

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htio e nel:e ctronic component fails when first

used $) = P(F) = 0.10$
$\therefore P(\bar{F}) = 1 - P(F) = 0.90$

Let E be the event that a new component will last for one year, then

$$P(E) = P(F) \cdot P\left(\frac{E}{F}\right) + P(\bar{F}) P\left(\frac{E}{\bar{F}}\right)$$

[Total probability theorem]

$= 0.10 \times 0 + 0.90 \times 0.99 = 0.891$

119. Given below is the distribution of a random variable X

X = x	1	2	3	4
P(X = x)	λ	2λ	3λ	4λ

P(X > 2), th en α : β =

BA (X < 3) and β =

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For a distribution of random variable x, $\alpha = P\left(X^6 < 3\right) = P\left(X^6 = 1\right) + P\left(X^6 = 2\right)$

$= \lambda + 2\lambda = 3\lambda$
and $\beta = P\left(X^6 < 2\right) = P\left(X^6 = 3\right) + P\left(X^6 = 4\right)$
$= 3\lambda + 4\lambda = 3\lambda$
$\therefore \quad \alpha : \beta = 3 : 7$

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$a+b+c=9; 0 \leq a,b,c \leq 9.$

$\therefore n(E) =$ Number of favourable ways

$=$ Number of solutions of the equation

$= {}^{9+3-1}C_{3-1} = {}^{11}C_2 = 55$

$\therefore$ Required probability

$= \frac{n(E)}{n(S)} = \frac{55}{1000} = \frac{11}{200}.$

, if P(A) = P(A/B) = 1/4 and P(B/A) = 1/2, then which

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tio n:

$$P\left(\frac{B}{A}\right)=\frac{1}{2}\Rightarrow\frac{P(B\cap A)}{P(A)}=\frac{1}{2}\Rightarrow P(B\cap A)=\frac{1}{8}$$

$$P\left(\frac{A}{B}\right)=\frac{1}{4}\Rightarrow\frac{P(A\cap B)}{P(B)}=\frac{1}{4}\Rightarrow P(B)=\frac{1}{2}$$

$$P(A\cap B)=\frac{1}{8}=P(A)\cdot P(B)$$

$\therefore$ Events A and B are independent.

Now, $P\left(\frac{A'}{B}\right)=\frac{P(A\cap B)}{P(B)}=\frac{P(A)P(B)}{P(B)}=\frac{3}{4}$

and $P\left(\frac{B'}{A'}\right)=\frac{P(B'\cap A')}{P(A')}=\frac{P(B')P(A')}{P(A')}=\frac{1}{2}$